

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

July 2007 (Final)

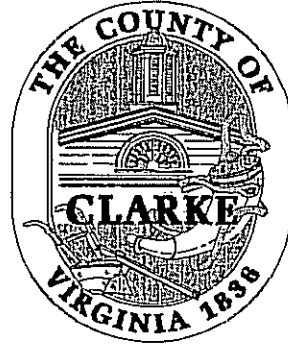


Clarke County Board of Supervisors

Supervisors
Millwood Voting District
John Staelin
Chair
(540) 837-1903

Berryville Voting District
J. Michael Hobert
Vice Chair
(540) 955-4720

Buckmarsh Voting District
David Weiss
(540) 955-2151



www.co.clarke.va.us

Supervisors
White Post Voting District
A.R. Dunning
(540) 837-1719

Russell Voting District
Barbara Byrd
(540) 955-1215

County Administrator
David L. Ash
(540) 955-5100
FAX: (540) 955-4002

HAZARD MITIGATION RESOLUTION 07-11

WHEREAS, the disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural mitigation plans in order to receive certain federal assistance; and,

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, The City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and,

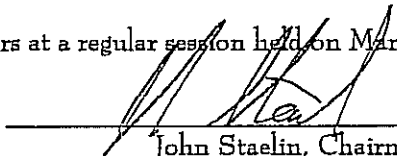
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and,

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Stanley.

NOW, THEREFORE BE IT RESOLVED BY THE Clarke County Board of Supervisors that the Hazard Mitigation Plan dated January 2007 is hereby approved and adopted for the County of Clarke, Virginia. A copy of the plan is available at the Office of the County Administrator.

Adopted by the Clarke County Board of Supervisors at a regular session held on March 20, 2007.

Attest:


John Staelin, Chairman
Clarke County Board of Supervisors

102 North Church Street, 2nd Floor, Berryville, VA 22611



BOARD OF SUPERVISORS

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

RESOLUTION ADOPTING A NATURAL HAZARDS MITIGATION PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES:

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

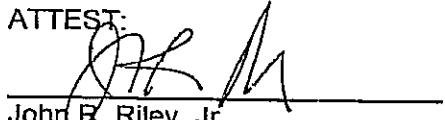
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including Frederick County, Virginia; and

NOW THEREFORE, BE IT RESOLVED by the Board of Supervisors for Frederick County, Virginia that the Hazard Mitigation Plan dated January 2007 is hereby approved and adopted for Frederick County, Virginia. A copy of the plan is attached to this resolution.

ADOPTED by the Board of Supervisors for Frederick County, Virginia this 11th day of April 2007.

ATTEST:


John R. Riley, Jr.

(Clerk of the Frederick County)

APPROVED:


Richard C. Shickle

(Chairman, Board of Supervisors)

Resolution # 059-07



COUNTY OF PAGE

117 South Court Street
Luray, Virginia 22835
(540) 743-4142
Fax: (540) 743-4533

Board of Supervisors:

Tommy R. LaFrance - Chairman-At-Large
Charles M. Hoke - District 1
John T. Rust - District 2
Charles C. Ballard - District 3
Gerald M. Cabbage - District 4
Carol Lee Fischer-Strickler - District 5

County Administrator:

Mark Belton

RESOLUTION OF THE PAGE COUNTY BOARD OF SUPERVISORS SUPPORTING THE NORTHERN SHENANDOAH VALLEY MULTI-JURISDICTIONAL HAZARDS MITIGATION PLAN

WHEREAS, Page County is part of the Northern Shenandoah Valley Multi-Jurisdictional Hazards Mitigation Plan; and

WHEREAS, the plan received a "satisfactory" rating for all required criteria; and

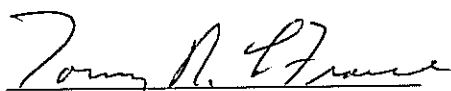
WHEREAS, each participating municipality in Northern Shenandoah Planning District Commission is required to provide FEMA an adoption resolution and final electronic copy of the adopted plan; and

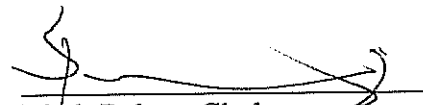
WHEREAS, FEMA commends the dedication demonstrated in supporting the Disaster Mitigation Act of 2000 and the Commission's commitment to reduce future disaster losses.

NOW BE IT RESOLVED, that the Page County Board of Supervisors strongly supports the Northern Shenandoah Valley Multi-Jurisdictional Hazards Mitigation Plan; and

BE IT FURTHER RESOLVED that the Page County Board of Supervisors supports this plan based on the standards contained in 44 Code of Federal Regulations (CFR), Part 201, as authorized by the Disaster Mitigation Act of 2000, and 44 CFR, Part 78.5 Flood Mitigation Plan Development.

Adopted by the Page County Board of Supervisors this 16th day of January 2007.


Tommy R. LaFrance, Chairman


Mark Belton, Clerk

County of Shenandoah

BOARD OF SUPERVISORS

600 North Main Street, Suite 102
WOODSTOCK, VA 22664

OFFICE OF COUNTY ADMINISTRATION

DISTRICT 1 - DICK NEESE 540-740-3414
DISTRICT 2 - JAMES PATRICK 540-856-8320
DISTRICT 3 - DAVID E. FERGUSON 540-984-8777
DISTRICT 4 - SHARON BARONCELLI 540-459-4165
DISTRICT 5 - DENNIS MORRIS 540-436-9149
DISTRICT 6 - CONRAD A. HELSLEY 540-465-4145



VINCENT E. POLING
COUNTY ADMINISTRATOR

MARY T. PRICE
ASSISTANT COUNTY ADMINISTRATOR

540-459-6165 • FAX 540-459-6168

Email: shenco@co.shenandoah.va.us

Website: <http://co.shenandoah.va.us>

Resolution of Support for a Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and


WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

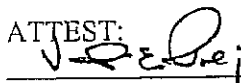
WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including Shenandoah County.

NOW, THEREFORE BE IT RESOLVED by the Shenandoah County Board of Supervisors that the Hazards Mitigation Plan dated March 27, 2007 is hereby approved and adopted for Shenandoah County. A copy of the plan is attached to this resolution.

Adopted this 27th day of March, 2007


Dick Neese, Chairman

ATTEST:


Vincent E. Poling, Clerk to the Board

Resolution



of the Board of Supervisors of Warren County

RESOLUTION ADOPTING NATURAL HAZARD MITIGATION PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

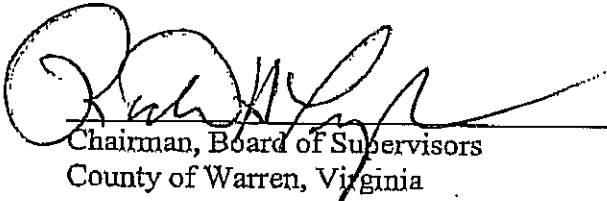
WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from the Counties of Clarke, Frederick, Page, Shenandoah, Warren, the City of Winchester and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from any vulnerabilities to natural hazards and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

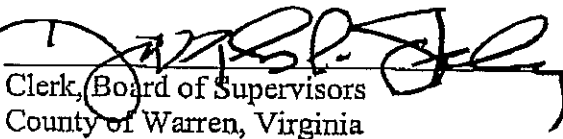
WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and nonprofit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including Warren County.

NOW, THEREFORE, BE IT RESOLVED by the Warren County Board of Supervisors that the Hazard Mitigation Plan dated January 2007 is hereby approved and adopted for the County of Warren.

Adopted: March 6, 2007


Chairman, Board of Supervisors
County of Warren, Virginia

ATTEST:


Clerk, Board of Supervisors
County of Warren, Virginia



THE COMMON COUNCIL

Rouss City Hall
15 North Cameron Street
Winchester, VA 22601
540-667-1815
TDD 540-722-0782
www.winchesterva.gov

I, Cody A. Doland, Deputy Clerk of the Common Council, hereby certify on this 25th day of April, 2007, that the following Resolution is a true and exact copy of one and the same adopted by the Common Council of the City of Winchester, assembled in regular session on the 10th day of April, 2007.

RESOLUTION

Resolution Approving a Natural Hazards Mitigation Plan for Northern Shenandoah Valley Communities

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from the Counties of Clarke, Frederick, Page, Shenandoah, Warren, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley risk from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop and comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the City of Winchester.

NOW THEREFORE, BE IT RESOLVED by the Common Council of the City of Winchester that the Hazard Mitigation Plan January 2007 is hereby approved and adopted for the City of Winchester.

Resolution No. 2007-13.

ADOPTED by the Common Council of the City of Winchester on the 10th day of April, 2007.

Witness my hand and the seal of the City of Winchester, Virginia.


Cody A. Doland
Deputy Clerk of the Common Council

**A RESOLUTION SUPPORTING THE ADOPTION OF A
NATURAL HAZARD MITIGATION PLAN FOR THE
NORTHERN SHENANDOAH VALLEY COMMUNITIES:**

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance; and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clark County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effect of such hazards on the Northern Shenandoah Valley; and


WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Edinburg;

NOW, THEREFORE BE IT RESOLVED by the Edinburg Town Council that the Hazard Mitigation Plan dated January 2007 is hereby approved and adopted for the Town of Edinburg. A copy of the Plan is attached to this resolution.

ADOPTED by the Town of Edinburg this 13th day of February, 2007

Approved:



Daniel J. Harshman, Mayor-Town Manager

Attest:



Lynn D. Reid, Clerk-Treasurer

**RESOLUTION ADOPTING A NATURAL HAZARDS MITIGATION PLAN FOR
NORTHERN SHENANDOAH VALLEY COMMUNITIES:**

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

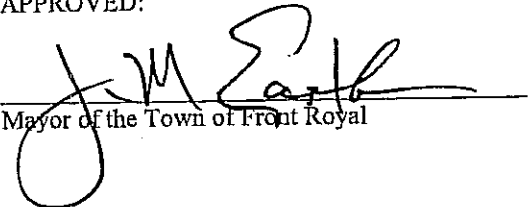
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Front Royal.

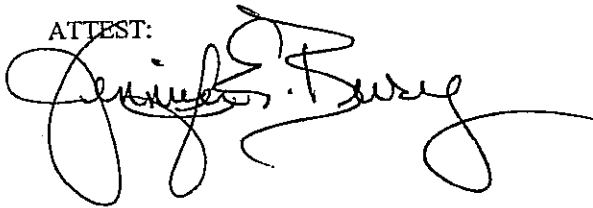
NOW THEREFORE, BE IT RESOLVED by the Front Royal Town Council that the Hazard Mitigation Plan is hereby approved and adopted for the Town of Front Royal. A copy of the plan is attached to this resolution.

ADOPTED by the Town of Front Royal this 14th day of May, 2007.

APPROVED:


Mayor of the Town of Front Royal

ATTEST:



**RESOLUTION ADOPTING A NATURAL HAZARDS
MITIGATION PLAN FOR NORTHERN SHENANDOAH
VALLEY COMMUNITIES:**

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

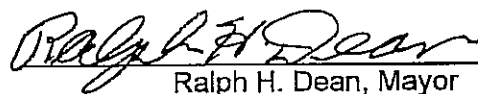
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and


WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including (jurisdiction name).

NOW THEREFORE, BE IT RESOLVED by the Luray Town Council that the Hazard Mitigation Plan dated January 2007 is hereby approved and adopted for the Town of Luray. A copy of the plan is on record at the Town Office.

ADOPTED by the Town of Luray, this 12th day of February, 2007.

APPROVED:


Ralph H. Dean, Mayor

ATTEST: 
Deputy Clerk - Treasurer

Resolution-04-2007

**RESOLUTION OF THE MAYOR AND COUNCIL OF THE TOWN OF
MOUNT JACKSON ADOPTING A NATURAL HAZARDS MITIGATION
PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES**

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

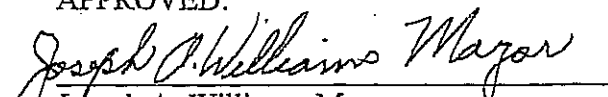
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Mount Jackson.

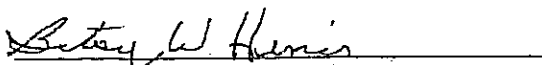
NOW, THEREFORE, BE IT RESOLVED by the Mayor and Town Council of the Town of Mount Jackson that the Hazard Mitigation Plan dated January, 2007 is hereby approved and adopted for the Town of Mount Jackson. A copy of the plan is attached to this resolution by Reference.

ADOPTED this 13th day February, 2007.

APPROVED:


Joseph A. Williams, Mayor

ATTEST:


Judy L. Hult, Town Clerk
Asst. Town Clerk

TOWN OF NEW MARKET
Resolution #177

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisor Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

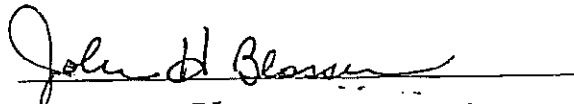
WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of New Market.

NOW THEREFORE, BE IT RESOLVED by the Town Council of the Town of New Market that the Hazard Mitigation plan dated January 2007 is hereby approved and adopted for the Town of New Market. A copy of the plan is kept at the New Market Municipal Offices.

ADOPTED by the Town of New Market this 19th, day of March 2007

APPROVED:


John H. Blosser, Vice-Mayor

ATTEST



RESOLUTION

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance; and

WHEREAS, a Mitigation Advisory Committee (MAC) comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and


WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Shenandoah.

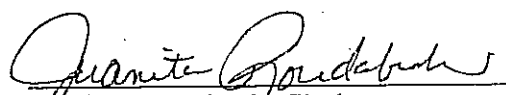
NOW, THEREFORE BE IT RESOLVED, BY THE SHENANDOAH TOWN COUNCIL that the Hazard Mitigation Plan dated January 2007, is hereby approved and adopted for the Town of Shenandoah. A copy of the plan is attached to this resolution.

Adopted by the Shenandoah Town Council this 27th day of February, 2007.

Approved:

Attested:


Clinton O. Lucas, Jr., Mayor


Janita Roudabush, Clerk

HAZARD MITIGATION RESOLUTION

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee ("MAC") comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including the Town of Stanley.

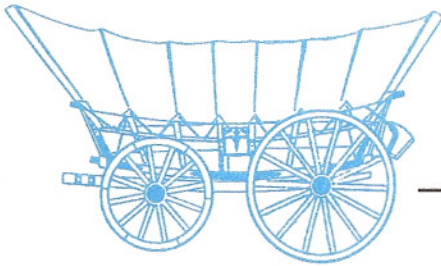
NOW THEREFORE, BE IT RESOLVED BY THE (governing board's name) that the Hazard Mitigation Plan dated () is hereby approved and adopted for the Town of Stanley. A copy of the plan is attached to this resolution.

ADOPTED by the Town of Stanley this 22nd day of Feb., 2007.

APPROVED: 

(Mayor Douglas Purdham)

ATTEST:



FOUNDED 1758

TOWN OF STEPHENS CITY

1033 Locust Street
P.O. Box 250
Stephens City, VA 22655-0250
(540) 869-3087 • Fax (540) 869-6166
E-mail: tosc@visuallink.com
Police (540) 868-1012

ADOPTING A NATURAL HAZARDS MITIGATION PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee (MAC) comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including Stephens City.

NOW THEREFORE, BE IT RESOLVED by the Town of Stephens City that the Hazard Mitigation Plan conditionally approved December 28th, 2006, with the amendments made specific to the Town of Stephens City as of May 30th, 2007 which includes the

Town's Capability Assessment and Goals and Strategies is hereby approved and adopted for the Town of Stephens City. A copy of the plan is attached to this resolution.

ADOPTED by the Town of Stephens City this 3rd day of July, 2007.

APPROVED:


Ray E. Ewing, Mayor

ATTEST:


Kathy C. Monk, Town Clerk

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

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Section I. Executive Summary

Background

Beginning in 2003, the Commonwealth of Virginia encouraged the twenty-one planning districts in the commonwealth to take the lead on the development of local hazard mitigation plans. These plans, which are required by the Disaster Mitigation Act of 2000 (DMA2K), help local governments to determine their risks and vulnerabilities and to identify projects to reduce these risks. The plan developed under the auspices of the Northern Shenandoah Valley Regional Commission includes Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock.

The planning district assembled a Mitigation Advisory Committee (MAC) comprised of representatives of the participating jurisdictions. The MAC worked with contractor support, Dewberry, to develop the plan, and provided input at key stages of the planning process. In addition, the plan was discussed at various public meetings, including a listening session to which over 60 organizations were invited to attend along with the general public.

Hazard Identification and Risk Assessment

The Hazard Identification and Risk Assessment consists of three parts:

1. Identification of hazards that could affect the Northern Shenandoah Valley
2. Profile of hazard events and determination of what areas and community assets are the most vulnerable to damage from these hazards
3. Estimate of losses and prioritization of the potential risks to the community

Hazards were ranked by the steering committee to determine what hazards they believe have the largest impact on their communities. Certain hazards were not addressed due to the infrequency of occurrence and/or limited impact. Table I-1 summarizes the results of the hazard identification, which is explained fully in Section V of this plan.

Table I-1. Northern Shenandoah Valley Planning Consideration Levels	
Hazard Type	Planning Consideration Level
Natural	
Winter Storm/ Extreme Cold	Significant
Flooding	Moderate
Wildfire	Moderate
Drought/ Extreme Heat	Limited
High Wind/ Hurricane	Limited

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Table I-1. Northern Shenandoah Valley Planning Consideration Levels

Hazard Type	Planning Consideration Level
Land Subsidence	Limited
Landslide/Steep Slope	Limited
Tornado/ Hail	Limited
Earthquake	None
Human-Caused	
Hazardous materials Spills	Limited
Pipelines	Limited
Mass Evacuation from Northern Virginia	Limited

The Hazard Identification and Risk Assessment describes each of the hazards in varying levels of detail, consistent with each planning consideration level. The Hazard Identification and Risk Assessment shows that snow storms generally have greater impact than ice storms. According to the flood analysis, potential flood losses are highest in Frederick County, the City of Winchester and the Town of Front Royal. In addition, rural areas are impacted more by drought and wildfire than urban areas.

Capability Assessment

The Capability Assessment evaluates the current capacity of the communities of the Northern Shenandoah Valley to mitigate the effects of the natural hazards identified in the Hazard Identification and Risk Assessment. By providing a summary of each jurisdiction's existing capabilities, the Capability Assessment serves as the foundation for designing an effective hazard mitigation strategy. Table I-2 summarizes the Capability Self-Assessment provided by the participating jurisdictions.

Table I-2. Capability Self-Assessment

<i>Jurisdiction</i>	<i>Planning Capability</i>	<i>Regulatory Capability</i>	<i>Administrative and Technical Capability</i>	<i>Fiscal Capability</i>	<i>Political Capability</i>	<i>Overall Capability</i>
Clarke County	High	High	Moderate	Limited	Moderate	Moderate/High
Frederick County	High	High	High	High	High	High
Page County	Limited	Moderate	Moderate	Limited	Moderate	Moderate
Shenandoah County	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Warren County	High	High	Moderate	Moderate	High	Moderate/High
City of Winchester	Limited	Moderate	Limited	Limited	Moderate	Limited

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Mitigation Strategy

The Northern Shenandoah Valley MAC members used the results of the Hazard Identification and Risk Assessment as well as the Capability Assessment to develop goals and mitigation strategies for their jurisdictions. The committee members developed the following nineteen goals in four categories:

A. Community Awareness

- A.1. Encourage leadership within the public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities as a public value.
- A.2. Establish cooperative relationships between the public, private, and non-profit sectors to enhance our preparedness, response, recovery, and mitigation for hazard events.
- A.3. Support pre-disaster mitigation and remedial efforts, should damage from a natural hazard event occur.
- A.4. Introduce hazard awareness and risk reduction principles into the community's daily activities, processes, and functions.
- A.5. Develop and implement education and outreach programs to increase public awareness of the risks associated with natural and man made hazards.
- A.6. Improve community education and communication as they relate to disasters.

B. Local Capacity

- B.1. Assess the extent of our vulnerability to natural and man-made environmental hazards.
- B.2. Enhance the capabilities of local government to lessen the impacts of future disasters.
- B.3. Improve hazard assessment information to make recommendation to discourage new development and encourage preventative measures for existing development in areas vulnerable to natural and man-made hazards.
- B.4. Leverage additional federal, non-federal, and state resources in meeting natural disaster resistance goals.
- B.5. Encourage scientific study of natural and man-made hazards and the development of data to support mitigation strategies for those hazards that are a threat to the region and localities within.

C. Property Protection

- C.1. Minimize the impact of natural and man-made hazards on property with the region and localities within and promote future disaster resistant development.
- C.2. Protect new and existing public and private infrastructure and facilities from the effects of natural and man-made hazards.
- C.3. Reduce damage to personal and public property including critical facilities.

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C.4. Identify and protect critical services, buildings, facilities and infrastructure at risk to natural and man-made hazards and undertake cost-effective mitigation measures.

D. Public Safety

D.1. Enhance the safety of residents and businesses by protecting new and existing development from the effects of natural and man-made hazards through efficient policies and procedures.

D.2. Ensure public health and safety within the region and localities within before, during, and following hazardous events.

D.3. Protect the citizens to the best of our abilities from natural and man-made environmental hazards to reduce the loss of life and personal injury.

D.4. Create coordinated regional emergency response criteria to establish services through the use of federal, state, regional and local resources utilizing a regional reciprocating agreement.

In addition, the committee identified and prioritized actions for each jurisdiction. The priorities differ somewhat from jurisdiction to jurisdiction. Each jurisdiction's priorities were developed based on past damages, existing exposure to risk, community goals, and their capabilities as identified in the Capability Assessment.

Plan Maintenance Procedures

The plan outlines a procedure for implementing, maintaining, and updating the plan. The Mitigation Advisory Committee that was established by the Northern Shenandoah Valley Regional Commission to develop this plan will remain active in monitoring and updating the plan. A working group also will be responsible for setting measures of success.

A 5-year written update to the plan must to be submitted to the state and FEMA Region III, unless disaster or other circumstances (e.g., changing regulations) lead to a different time frame. Efforts will be made to inform the public of the implementation and updating of the mitigation plan throughout the next five years.

Conclusion

This plan symbolizes the continued commitment and dedication of the Northern Shenandoah Valley's local governments and community members to enhancing the safety of residents and businesses by taking actions before a disaster strikes. Although nothing can be done to prevent natural hazard events from occurring, the region is now poised to minimize the disruption and devastation that so often accompanies these disasters.

Section II. Introduction

Mitigation

Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and the impacts of hazards. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. A mitigation plan states the aspirations and specific courses of action that a community intends to follow to reduce their vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

A local mitigation plan is the physical representation of a jurisdiction's commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding regulations and ordinances, granting permits, and funding capital improvements or other community initiatives. Additionally, these local plans will serve as the basis for states to prioritize future grant funding as it becomes available.

It is hoped that the Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan will be a useful tool for all community stakeholders by increasing public awareness about local hazards and risks, while at the same time providing information about options and resources available to reduce those risks. Teaching the public about potential hazards will help each of the area's jurisdictions protect themselves against the effects of hazards, and will enable informed decision making on where to live, purchase property, or locate businesses.

The geographic area covered by this plan includes Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock.

The Local Mitigation Planning Impetus

On October 30, 2000, President Clinton signed into law the Disaster Mitigation Act of 2000 (DMA 2000), which established a national pre-disaster hazard mitigation grant program that would help to reduce loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters.

DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act and added a new section to the law, Section 322 Mitigation Planning. Section 322 requires local governments to prepare and adopt jurisdiction-wide hazard mitigation plans for disasters declared after November 1, 2003, (subsequently revised to November 1, 2004) as a

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condition of receiving Hazard Mitigation Grant Program (HMGP) project grants and other forms of non-emergency disaster assistance. Local governments must review and, if necessary, update the mitigation plan every five years from the original date of the plan to continue program eligibility.

Interim Final Rule Planning Criteria

As part of the process of implementing DMA 2000, FEMA prepared an Interim Final Rule to define the mitigation planning criteria for States and communities. Published in the *Federal Register* on February 26, 2002, at 44 CFR Part 201, the Rule serves as the governing document for DMA 2000 planning implementation.

Organization of the Plan

The remaining sections of this document follow the process outlined by DMA 2000 and the implementing regulations.

Section III – Planning Process describes the Northern Shenandoah Valley’s stakeholder involvement and defines the processes followed throughout the creation of this plan.

Section IV – Community Profile provides a physical and demographic profile of the area, examining issues such as geography, hydrography, development, people, and land uses.

Section V – Hazard Identification and Risk Assessment evaluates the natural hazards likely to affect the Northern Shenandoah Valley, and quantifies whom, what, where, and how the region might be affected by natural hazards.

Section VI – Capability Assessment analyzes each of the local jurisdictions’ policies, programs, plans, resources, and capabilities to reduce exposure to hazards in the community.

Section VI – Mitigation Strategy addresses the Northern Shenandoah Valley region’s issues and concerns for hazards by establishing a framework for mitigation activities and policies. The strategy includes a mission, statement, goals, objectives, and a range of actions to achieve the goals.

Section VIII – Plan Maintenance Procedures specifies how the plan will be monitored, evaluated, and updated, including a process for continuing stakeholder involvement once the plan is completed.

Section IX – References includes a list of reports and data used to develop this plan.

Appendices are included at the end of the plan, and contain supplemental reference materials and more detailed calculations and methodologies used in the planning process. The appendices also provide a list of commonly used mitigation terms and acronyms.

Section III. Planning Process

The Northern Shenandoah Valley Regional Commission was formed by its local governments in 1968 under the authority of the Virginia Area Development Act. The Commission is made up of eighteen elected officials and twelve citizens appointed to the Commission by the eleven member local governments. The Commission provides a variety of technical services to its member local governments including: planning, mapping, grant application assistance, and network meetings. Programs which serve citizens, the private and non-profit sectors include:

- The region's Map, Data & GIS Center as part of PDConnect, the statewide network of PDCs,
- Valley Commuter Assistance Program Rideshare - Northern Shenandoah Valley, the program for commuters and employers networked with Commuter Connections,
- The Northern Shenandoah Valley Economic Development Network, with the assistance of corporate members,
- The Lord Fairfax Disability Services Board, and
- The Regional Tire Operations Program.

Beginning in 2003, the State of Virginia encouraged the twenty-one planning districts in the state to take the lead on development of local hazard mitigation plans. These plans, which are required by DMA 2000, help local governments to determine their risks and vulnerabilities and identify projects to reduce these risks. The plan developed under the auspices of the Northern Shenandoah Valley Regional Commission includes Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock.

After receiving funding in 2004, the Northern Shenandoah Valley Regional Commission contracted with the engineering consulting firm, Dewberry, to develop a multi-hazard mitigation plan including a Hazard Identification and Risk Assessment (HIRA) and mitigation strategies. The Mitigation Advisory Committee worked with the consultants throughout the planning process to ensure that potential stakeholders participated in the planning process and had opportunities for input in the draft and final phases of the plan.

The Mitigation Advisory Committee

The Commission convened a Mitigation Advisory Committee (MAC) comprised of representatives of the participating jurisdictions. The MAC worked with the Dewberry team and provided input at key stages of the process. Efforts to involve city and county departments and community organizations that might have a role in the implementation of

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the mitigation actions or policies included invitations to attend meetings and serve on the MAC, access to the project website (projects.dewberry.com/wpiedHMP), e-mail updates, strategy development workshops, plus opportunities for input and comment on all draft deliverables.

The Northern Shenandoah Valley Regional Commission would like to thank and acknowledge the following persons and their respective departments and organizations who served on the MAC throughout the planning process:

Table III-1. Northern Shenandoah Valley Mitigation Planning Participants		
Name	Title and/or Department	Jurisdiction
Jeff Boyer	Environmental Specialist/Virginia Department of Transportation	Region
Cindy Breeden	Treasurer	Town of Shenandoah
Tamara Caldwell	Mitigation Planner/Virginia Department of Emergency Management	State
Page Campbell	Luray Police Department	Town of Luray
Larry Carpenter	PREP Coordinator/Virginia Department of Environmental Quality	Region
Gary DuBrueler	Emergency Management Coordinator	Frederick County
Mary Embrey	Administrative Assistant/Town Manager's Office	Town of Mount Jackson
David E. Ferguson	Fire Marshall	Shenandoah County
Harold Fisher	Virginia Department of Forestry	Region
Dan Harshman	Mayor-Town Manager	Town of Edinburg
Brian Henshaw*	Director/Planning Department	Page County
	Town Planner	Town of Stephens City
Hibak Hersi	Mitigation Planning Coordinator/Virginia Department of Emergency Management	State
Samantha Johnson	Wildfire Mitigation Specialist/Virginia Department of Forestry	Region
Chuck Johnston	Planning Administrator	Clarke County

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Table III-1. Northern Shenandoah Valley Mitigation Planning Participants

Steve Kerr	Executive Director/ Northern Shenandoah Valley Regional Commission	Region
Rob Kinsley	Senior Planner	Shenandoah County
Richard Kurzenknabe	Police Department	Town of Front Royal
Taryn Logan	Deputy Planning Director	Warren County
Todd E. Lupton	Emergency Management	Warren County
Richard E. Mabie	Fire and Rescue Chief/Emergency Management Coordinator	Warren County
Stephanie Manjino	Reporter/The Winchester Star	Region
Lynn Miller	Emergency Management Coordinator	City of Winchester
Deborah Mills	Hazard Mitigation Program Manager/Virginia Department of Emergency Management	State
Terry Petit	Town Manager	Town of Stanley
Tine Presley	Senior Administrative Assistance/Town Manager's Office	Town of Front Royal
David Powell	Assistant Forester/Virginia Department of Forestry	Region
Richard A. Sisler	Emergency Management/EDS	Winchester
Gene P. Stewart, Jr.	Emergency Services Coordinator	Page County
Bruce Sterling	Region II Coordinator/ Virginia Department of Emergency Management	Region
James Watson	Emergency Management Specialist	Frederick County
Ronnie Williamson	Police Department	Town of Front Royal
Frank E. Wright	Chief/Fire and Rescue Department	City of Winchester
Evan Vass	Town Manager	Town of New Market
Captain Mart Viggiano	Fire and Rescue Department	Warren County
Gary Yew	Emergency Management Coordinator	Shenandoah County

** During the first phase of the planning process, Mr. Henshaw was a Community Planner with the Northern Shenandoah Valley Regional Commission.

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Between December 2004 and June 2006, the MAC convened eight meetings and supervised work on the area's mitigation plan. The MAC members coordinated and consulted with other entities and stakeholders to identify and delineate natural hazards within the seven local jurisdictions and to assess the risks and vulnerability of public and private buildings, facilities, utilities, communications, transportation systems, and other vulnerable infrastructure. The towns in the Northern Shenandoah Valley region were invited to participate in the planning process and chose to do so by allowing their respective County representatives to represent their interests. The county representatives met with town officials between MAC meetings and provided input from the towns at MAC meetings.

In developing the mitigation plan, a majority of necessary communication occurred through telephone calls and emails. The MAC and its consultant chose this avenue to best accommodate the project budget and schedules of the participants. A project website (<http://projects.dewberry.com/nsvrchmp>) was established to facilitate the planning process. Table III-2 documents formal meeting dates and their purposes.

Table III-2. Mitigation Advisory Committee Meetings	
Meeting Dates	Summary of Discussions
December 1, 2004	Initial meeting of Mitigation Advisory Committee. Discussed overall process and proposed planning approach. Discussed hazards that could impact the Northern Shenandoah Valley.
May 23, 2005	Kick-off meeting to introduce consultants to Mitigation Advisory Committee. Conducted hazard problem-spot exercise to identify local areas of concern.
June 8, 2005	Discussed risk assessment priorities. Began discussion of mitigation goals. Decided on format for capability assessment survey. Discussed project website.
July 23, 2005	Discussed capability assessment. Discussed project website.
November 18, 2005	Results of the HIRA were presented. An overview of mitigation strategies or alternatives was presented.
January 11, 2006	Developed mitigation goals. Discussed how to develop mitigation strategies. Discussed progress on developing capability assessment.
May 11, 2006	Reviewed mitigation goals. Discussed mitigation strategies development. Discussed plan maintenance procedures.
June 29, 2006	Reviewed draft plan. Provided feedback to consultant on plan. Discussed plan implementation.

Public Participation and Citizen Input

The public was afforded several opportunities to provide input and to participate throughout the planning process. The hazard mitigation plan was discussed at several Northern Shenandoah Valley Regional Commission meetings, which are advertised and open to the

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public. In addition, prior to plan adoption, the plan was discussed at public meetings in each jurisdiction.

The draft plan was made available on the Commission's website (<http://www.lfpdc7.state.va.us/>) as well as individual jurisdiction websites. Hard copies were made available for review at the planning offices and libraries in each participating jurisdiction. The plan also was the subject of several regional newspaper articles and advertisements.

Neighboring jurisdictions were invited to review and provide input into the plan. These jurisdictions included:

Virginia:

- Northern Virginia Regional Commission
- Rappahannock-Rapidan Regional Commission
- Central Shenandoah Planning District Commission (PDC)
- Thomas Jefferson PDC

West Virginia:

- Region 8 – Planning and Development Council
- Region 9 – Eastern Panhandle Regional Planning and Development Council

Participating jurisdictions were encouraged to obtain formal acknowledgement of the MAC from their governing boards, and to appoint MAC members by resolution.

The Northern Shenandoah Valley Regional Commission used existing contacts lists as a basis to develop a list of interested parties in the hazard mitigation planning process. The lists included county and city administrative officers, community planners, economic development planners, educational organizations (such as Lord Fairfax Community College, Shenandoah University and local school districts), social service organizations (such as Shenandoah Area Agency on Aging, Northern Shenandoah Valley Disability Services Board, Winchester - Frederick County Chapter of the American Red Cross), and chambers of commerce (such as Winchester/Frederick County Chamber of Commerce, Warren County/Town of Front Royal Chamber of Commerce).

The Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan incorporates a number of other plans, studies and reports that have been produced about the Northern Shenandoah Valley. These documents include the Commonwealth of Virginia's Hazard Mitigation Plan; FEMA Flood Insurance Studies for the participating jurisdictions; Clarke County, Planning and Zoning Department 2005 Annual Land Use Report; Clarke County Mountain Land Plan 2005; 2003 Frederick County Comprehensive Policy Plan; Selected Karst Features of the Northern Valley and Ridge Province, Virginia by David Hubbard

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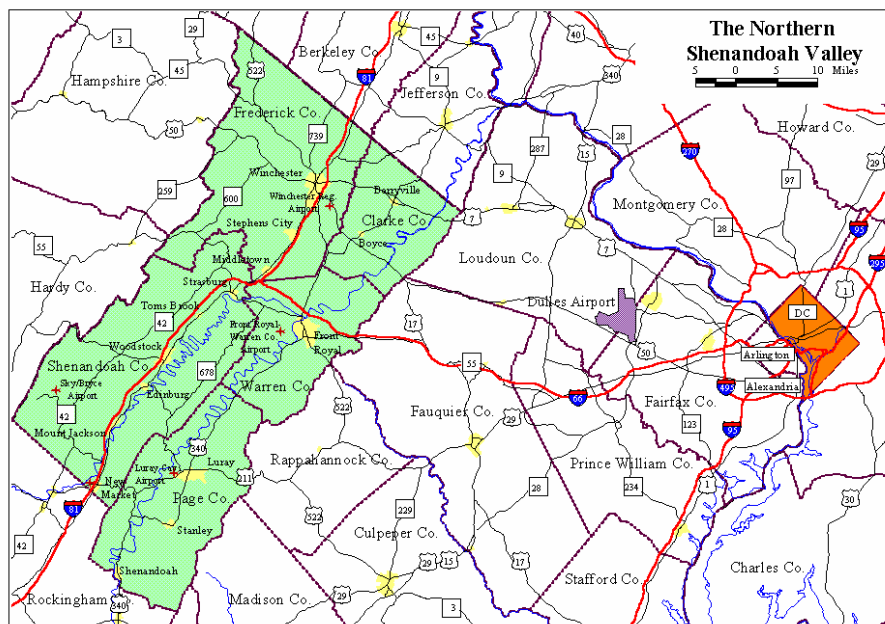
(1983); Shenandoah County Comprehensive Plan 2005; Warren County Comprehensive Plan 2004. Information about these plans and studies is included in Sections V and VI of the plan, and full reference information is provided in Section X.

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Section IV. Community Profile

Location

The Northern Shenandoah Valley is the crossroads for Interstates 81 and 66; U.S. Routes 11, 17, 50, 211, 340, and 522; and Virginia Routes 7, 37, 42, 55, 263, and 277. As a transportation hub, it provides overnight access to 60% of U.S. industrial activities, is within 500 miles of 50% of the U.S. population, and offers direct access to Canadian markets via I-81. The Virginia Inland Port, a truck to rail intermodal container terminal, provides local industry with a worldwide trade reach. Dulles International Airport, 35 miles east, also provides the area with airfreight trade and over 28 International destinations. Furthermore, with fiber optic connections and the use of the Internet, the Northern Shenandoah Valley has become an ideal location for businesses providing cutting-edge technology to the global marketplace.



Population

In Virginia, statistical data is tabulated by county, city, town and planning district. Cities and counties are separate political entities and do not have any overlap in data. County data in this profile includes the following local jurisdictions: Clarke Co.- Berryville & Boyce; Frederick Co. – Middletown & Stephens City; City of Winchester; Page Co. – Luray, Shenandoah, & Stanley; Shenandoah Co. – Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook & Woodstock; and Warren Co. – Front Royal. Table IV-1 shows the Northern Shenandoah Valley population and projected population by jurisdiction.

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Table IV-1. City, County, and Regional Population/Projections (Projected February 2004)

City/ County	1990	2000	2004 (Prov.)	2010	2020	2030
Frederick Co.	45,723	59,209	66,300	68,300	78,600	89,400
City of Winchester	21,947	23,585	25,500	25,800	27,600	29,800
Frederick Co. / City of Winchester	67,670	82,794	91,800	94,100	106,200	119,200
Clarke Co.	12,101	12,652	13,700	14,900	16,400	18,300
Page Co.	21,690	23,177	23,700	25,400	27,500	30,200
Shenandoah Co.	31,636	35,075	38,300	39,100	43,000	47,600
Warren Co.	26,142	31,584	33,900	37,800	43,100	48,800
NSV Regional Commission	159,239	185,282	201,400	211,300	236,200	264,100
<i>(Population projections were based off the Weldon Cooper Center Demographics for Provisional Projections)</i>						

Table IV-2. Number of Households in Northern Shenandoah Valley

	1980	1990	2000	2010	2020
Northern Shenandoah Valley Regional Commission (Population)	132,492	159,239	185,282	213,984	240,869
Total Number of Households	47,665	60,176	72,728	85,684	98,210
<i>(Projected March 2001)</i>					

Median Family Income

Table IV-3. Median Family Income

County/ Jurisdiction	Income
Clarke County	\$59,750
<i>Berryville</i>	\$52,176
<i>Boyce</i>	\$52,000
Frederick County	\$52,281
<i>Middletown</i>	\$42,031
<i>Stephens City</i>	\$41,827
City of Winchester	\$44,675
Page County	\$39,005
<i>Luray</i>	\$39,972
<i>Shenandoah</i>	\$37,896
<i>Stanley</i>	\$33,187
Shenandoah County	\$45,080
<i>Edinburg</i>	\$37,986
<i>Mount Jackson</i>	\$39,423
<i>New Market</i>	\$48,036

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Table IV-3. Median Family Income

County/ Jurisdiction	Income
<i>Strasburg</i>	\$40,978
<i>Toms Brook</i>	\$44,688
<i>Woodstock</i>	\$38,778
Warren County	\$50,487
<i>Front Royal</i>	\$42,863
<i>(Based on Census 2000 Demographic Profiles)</i>	

Commerce

Table IV-4. Northern Shenandoah Commerce Statistics

City/County	Total Number of Business License's Issued*		Shopping Centers**	Lodging	# of Rooms
	2003	2004			
Frederick Co.	4,453	5,144	6	21	1,179
City of Winchester	3,362	3,752	22	11	539
Frederick Co. / City of Winchester	7,815	8,896	28	32	1,718
Clarke Co.	930	1,573	0	5	44
Page Co.	1,298	1,508	6	40	1,100
Shenandoah Co.***	1,138	1,225	5	13	693
Warren Co.	2,899	4,219	4	15	595
NSV Regional Commission	14,080	17,421	43	105	4,150
* The total number of businesses licensed includes all of the Towns within each of the Counties.					
** For the purposes of this report, shopping centers are defined as the following:					
<ul style="list-style-type: none"> • Three or more stores under one roof or connected roof greater than 30,000 sq. ft. • One store w/ more than three shops within that is greater 100,000 sq. ft. 					
*** Shenandoah County does not issue business permits; figures represent licenses issued by towns					

Medical

Hospitals:

Winchester Medical Center (WMC) serves the Virginia, West Virginia, and Maryland tri-state area providing complete health care. The WMC is owned and operated by the Valley Health System. The WMC features their Heart Center, which was ranked as one of the Top 100 in the nation, a Cancer Center, and an Inpatient/Outpatient Rehab Center.

Warren Memorial Hospital located in Front Royal, Virginia is a sister hospital to WMC as they both are owned and operated by Valley Health System. Warren Memorial offers a Women's Care Center and a 40 bed Nursing Home as part of the hospital's facilities.

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Shenandoah Memorial Hospital located in Woodstock, Virginia, provides primary health care to Shenandoah County and is owned and operated by Valley Health System. Shenandoah Memorial Hospital features their Family Centered Maternity Ward, Intensive/ Coronary Care Unit and Ambulatory Surgery.

Page Memorial Hospital is located in Luray, Virginia and provides primary health care to the immediate surrounding area of Page County.

VA Medical Center in Martinsburg, West Virginia provides quality medical care to veterans in the Northern Shenandoah Valley. An Outpatient clinic is now available in Stephens City on Aylor Rd. Emergency airlift is available by Pegasus to the University of Virginia Medical Center and by medivac to INOVA Medical Center.

Table IV-5. Medical Facility Statistics

City/ Counties	Licensed Medical or Surgical Physicians*	Licensed Dentists*	Health Clinic	Assisted Living	Nursing Homes	Hospital Patient Beds
Clarke Co.	11	2	0	2	2	0
Frederick Co. / City of Winchester	295	40	6	4	3	411
Page Co.	14	6	1	5	2	54
Shenandoah Co.	38	13	3	3	11	25
Warren Co.	27	11	4	1	2	196
NSV Regional Commission	385	72	14	15	20	

**Source: Virginia Department of Health Professions*

Education

Table IV-6. Education Statistics

Public Schools 2003-2004	Number of Schools			Number of Teachers	Enrollment 2003-2004	Anticipated Graduating Class
	Elem.	Mid.	High			
Clarke County*	3	1	1	230	2,173	148
Frederick County	10	3	3	952	11,763	730
City of Winchester	4	1	1	325	3,646	200
Page County	5	0	2	284	3,536	236
Shenandoah County	3	3	3	476	5,880	405
Warren County**	5	2	1	398	5,163	353
NSV Regional Commission	30	10	11	2,672	32,161	2,072

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Table IV-6. Education Statistics

Public Schools 2003-2004	Number of Schools			Number of Teachers	Enrollment 2003-2004	Anticipated Graduating Class
	Elem.	Mid.	High			
<i>Enrollment Figures as of March, 2005</i>						
<i>*Clarke Co. has 1 Primary School (Included in the Elementary Total.)</i>						
<i>**Warren County has a Junior High School included the Middle School Totals</i>						

Private Education (Elementary and Secondary) serving NSV Regional District:

- ❖ **Clarke Co.:** Keystone Christian Academy; Powhatan School
- ❖ **Frederick Co.:** Mountain View Christian Academy; Rosedale Christian Academy; Shenandoah Valley Christian Academy,
- ❖ **City of Winchester:** Sacred Heart Academy; Winchester Montessori School
- ❖ **Page Co.:** Mount Carmel Christian Academy; Seventh-Day Adventist
- ❖ **Shenandoah Co.:** Massanutten Military Academy; Shenandoah Valley Academy; Shenandoah Valley Elementary School; Valley Baptist Christian School; Community Christian School
- ❖ **Warren Co.:** Academy at Innisfree; Guardian Angel Academy; Little Sheep School and Preschool; Mountain Laurel Montessori School; Randolph- Macon Academy; Royal Christian Academy; Wakefield Country Day School

Special Education:

- ❖ Clarke Co: Grafton School (Also has several locations in the City of Winchester)
- ❖ Frederick Co: Timber Ridge

Public Vocational:

- ❖ Frederick Co: Dowell J. Learning Center
- ❖ Page Co: Page County Vocational/ Technical Center; Stanley
- ❖ Shenandoah Co: Triplett Business and Technical Institute; Mt. Jackson
- ❖ Warren Co: Warren Co. Vocational Technical Center; Front Royal

Higher Education (Within NSV Regional Commission):

Christendom College is a private four-year Roman Catholic College nestled in the hills of Front Royal, Virginia. The College focuses on sending the “complete student” out into the world with the knowledge to succeed in all life’s obstacles.

Lord Fairfax Community College is a public two-year college that focuses on educating the community to ensure that the individuals in the Northern Shenandoah Valley are provided with a continuing opportunity for the development and extension of their skills and

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knowledge through quality programs and services that are financially and geographically accessible.

Shenandoah University is a growing university in the City of Winchester. Shenandoah focuses on providing students with culturally diverse education as well as professional and academic training necessary to develop their talents for the future.

The Northern Shenandoah Valley Library Network links the collections of Shenandoah University, Lord Fairfax Community College, Samuels Public Library and Warren County High School.

Regional Climate

The Northern Shenandoah Valley enjoys a temperate climate. Average temperatures are provided in Table IV-7.

Table IV-7. Northern Shenandoah Valley Climate Statistics					
Region	Avg. Temp.	Avg. Temp. Jan	Avg. Temp. July	Avg. Rainfall	Avg. Snowfall
NSV Region	54.5 F	33.8 F	75.4 F	37.7"	25.4"

Communications

Telephone Service:

Local: Adelphia, Intelos, Sprint, Shenandoah Telephone Co., Verizon

Long Distance: Equal Access for all of District Region

Internet Providers:

- ❖ Adelphia
- ❖ Intelos
- ❖ Megapipe Communications
- ❖ Shentel Internet Access
- ❖ Virginia Internet Express
- ❖ Velocitus Internet
- ❖ Visual Link Inc.
- ❖ Warren Systems

Newspapers:

Daily (State and Local)

- ❖ Daily News Record, (Harrisonburg)

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- ❖ Northern Virginia Daily, (Strasburg)
- ❖ The Richmond Times Dispatch, (Richmond)
- ❖ The Washington Post, (Washington, DC)
- ❖ The Winchester Star, (Winchester)

Weekly (Local)

- ❖ Clarke Courier, (Berryville)
- ❖ Page News and Courier, (Luray)
- ❖ Shenandoah Valley Herald, (Woodstock)
- ❖ The Warren Sentinel, (Front Royal)
- ❖ The Free Press, (Woodstock)

Monthly (Regional)

- ❖ Quad State Business Journal, (Winchester)

Radio Stations:

- ❖ 91.3 WTRM (FM), Winchester
- ❖ 92.5 WINC (FM), Winchester
- ❖ 93.7 WAZR (FM), Woodstock
- ❖ 95.3 WFTR (FM), 1450 AM, Front Royal
- ❖ 96.9 WISG (FM), 790 (AM), Mt. Jackson
- ❖ 99.3 WFQX (FM), Strasburg
- ❖ 102.5 WUSQ (FM), 610 (AM), Winchester
- ❖ 103.3 WEZI (FM), Harrisonburg
- ❖ 104.9 WAPP (FM), Berryville
- ❖ 105.1 WAMM (FM), Woodstock
- ❖ 105.5 WBPP (FM), Berryville
- ❖ 105.7 WZXI (FM), Luray
- ❖ 610 WNTW (AM), Winchester
- ❖ 1300 WRAA (AM), Luray
- ❖ 1400 WINC (AM), Winchester

Television Stations:

- ❖ None based in NSVRC

Cable Television Providers:

- ❖ Adelphia - Clarke, Frederick, Page, Warren Counties; City of Winchester
- ❖ Shentel - Shenandoah County.

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Government

There are four types of incorporated forms of government in the Northern Shenandoah Valley. Table IV-8 identifies which jurisdictions fall into which form of government.

Table IV-8. Northern Shenandoah Valley Forms of Government	
Form of Government	Jurisdiction
County Government: Chairman/Board/ Administrator	Clarke, Frederick, Page, Shenandoah, and Warren
City Government: President/ Council/Manager	Winchester
Town Government: Mayor/ Council/Manager	Berryville, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, and Woodstock
Town Government: Mayor/ Council/Clerk and Recorder	Boyce and Toms Brook

Law Enforcement

Table IV-9 shows the number of law enforcement departments and officers in the Northern Shenandoah Valley.

Table IV-9. Law Enforcement Statistics				
City/County	Sheriff Depts.	Deputies	Police Depts.	Officers
Frederick Co.	1	94	2	9
City of Winchester	1	7	1	71
Frederick Co. / City of Winchester	2	101	3	80
Clarke Co.	1	18	1	9
Page Co.	1	55	3	21
Shenandoah Co.	1	63	5	40
Warren Co.	1	75	1	35
NSV Regional Commission	6	312	13	185

Fire and Rescue

Table IV-10 shows the number of fire and rescue companies and personnel in the Northern Shenandoah Valley.

Table IV-10. Fire and Rescue Statistics			
City/ County	Number of Companies	Paid Personnel	Approximate # of Volunteers
Clarke Co.	4	5	80
Frederick Co.	11	65	405

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Page Co.	6	3	215
Shenandoah Co.	13	31	550
Warren Co.	9		
City of Winchester	4	46	53
NSV Regional Commission	45	61	1,378

Development Process:

- ❖ All jurisdictions have Planning Commissions, Zoning Regulations and an Industrial Site Approval process.

Utilities and Services

Electricity:

- ❖ **Power Suppliers:** Allegheny Power System and Virginia Power
- ❖ **Power Distributors:** Allegheny Power System, Virginia Power, Shenandoah Valley Electric Cooperative and the Town of Front Royal

Public Utilities:

Table IV-11. Water and Sewer Statistics				
City/ County	Water		Sewer	
	Maximum Capacity	Average Daily	Capacity Daily	Present Load
Clarke: Berryville	864,000GPD	406,000GPD	450,000GPD	56%
Boyce/Millwood/ White Post	180,000GPD	65,000GPD	None	None
Boyce/Millwood	-	-	50,000	44%
Frederick: Middletown	3,200,000GPD	2,213,000GPD	8,400,000GPD	58%
Stephens City	3,200,000GPD	2,213,000GPD	8,400,000GPD	58%
Page: Luray	1,224,000GPD	854,000GPD	2,400,000GPD	64%
Shenandoah	601,000GPD	246,359GPD	250,000GPD	56%
Stanley	529,600GPD	450,000GPD	300,000GPD	50%
Shenandoah: Bayse	269,000GPD	150,583GPD	600,000GPD	66%
Edinburg	250,000GPD	126,000GPD	175,000GPD	53%
Mt. Jackson	580,000GPD	301,000GPD	200,000GPD	90%
New Market	1,600,000GPD	545,000GPD	500,000GPD	90%
Strasburg	1,140,000GPD	800,000GPD	975,000GPD	82%
Toms Brook/ Maurertown	170,000GPD	95,000GPD	189,796GPD	52%
Woodstock	1,300,000GPD	750,000GPD	1,000,000GPD	55%
Warren: Front Royal	3,000,000GPD	2,131,000GPD	4,000,000GPD	62%
City of Winchester	10,000,000GPD	7,106,000GPD	8,400,000GPD	58%

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Solid Waste Disposal:

- ❖ Frederick Co. Sanitary Landfill (540 Acres) [also serves City of Winchester and Clarke Co.]
- ❖ Shenandoah Co. Sanitary Landfill (214 Acres)
- ❖ Warren Co. Waste Transfer Station (8 Acres)
- ❖ Page Co. Landfill (160 Acres)

Natural Gas Suppliers:

- ❖ Amerigas-Shengas Division
- ❖ Columbia Gas Transmission Corp.
- ❖ Shenandoah Gas Co.

LP Gas Distributors:

- ❖ Amerigas-Shengas Division
- ❖ Battle of Cedar Creek Campground
- ❖ Columbia Gas of Virginia
- ❖ Commonwealth Propane
- ❖ Holtzman Propane
- ❖ Petrolane Gas
- ❖ Quarles Petroleum, Inc.
- ❖ Roberts Oxygen Co. Inc.
- ❖ Shenandoah Valley Oil
- ❖ Southern States
- ❖ Tri-State Propane
- ❖ Valley Gas Corp.

Fuel Oil Distributors:

- ❖ Bauserman Oil
- ❖ Clarke Co. Supply
- ❖ E.N. Hershberger Co.
- ❖ Emmart's Luray Gas & Oil Co.
- ❖ Glover John D. & Sons
- ❖ H.N. Funkhouser & Co.
- ❖ Holtzman Oil Corp.
- ❖ Mercer Oil & Coal Co.
- ❖ Mowery Oil Co.
- ❖ Quarles Petroleum
- ❖ Shenandoah Valley Oil Co.
- ❖ Southern States
- ❖ Valley Discount Fuel Oil

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Coal Services:

- ❖ Al Shirley & Sons, Inc.
- ❖ Henry's Coal Yard; Mercer Oil & Coal Co.
- ❖ Orndorff's Coal Yard
- ❖ Vehrencamps

Labor Force and Analysis

Table IV-12 and 13 show the number of people in the Northern Shenandoah Valley workforce between 1974 and 2000.

Table IV-12. Labor Force Statistics by Year				
City/ County	1974*	1980	1990	2000**
Frederick Co.	15,498	18,077	25,986	33,736
City of Winchester	8,500	10,698	12,540	13,376
Frederick Co. / City of Winchester	23,998	28,775	38,526	47,112
Clarke Co.	3,698	5,134	6,418	6,782
Page Co.	7,998	8,610	11,226	11,884
Shenandoah Co.	11,090	12,906	16,555	17,567
Warren Co.	8,356	10,376	14,050	15,674
NSV Regional Commission	55,140	65,801	86,775	99,019
*1974 is as far as the Virginia Employment Commission could go back in their records, however, this is still an adequate depiction of how the NSV Region as grown over the last four decades.				
**As of January, 2005				

Table IV-13. Labor Force Statistics by Jurisdiction				
City/ County	Civilian Labor Force	Employed	Unemployed	Rate
Frederick Co.	37,057	36,016	1,041	2.8%
City of Winchester	13,936	13,428	508	3.6%
Frederick Co. / City of Winchester	50,993	49,444	1,549	3.2%
Clarke Co.	7,268	7,057	211	2.9%
Page Co.	11,620	10,915	705	6.1%
Shenandoah Co.	19,937	18,828	569	2.9%
Warren Co.	17,709	17,115	594	3.4%
NSV Regional Commission	112,527	103,359	3,628	3.62%

Transportation

The Northern Shenandoah Valley is served by a wide variety of transportation modes.

Local Airports:

- ❖ Front Royal – Warren County
- ❖ Luray Caverns Airport

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- ❖ New Market Airport
- ❖ Winchester Regional Airport (Customs Service; Parallel taxiway; and Terminal)

Bus Service:

- ❖ Greyhound
- ❖ Richards Bus Lines Inc. (Charter Bus Services)
- ❖ Schrock Tour and Charter Service
- ❖ Winchester Public Transit

Commercial/International Airport Services:

- ❖ Dulles International Airport in Loudon County
- ❖ Ronald Reagan Washington National Airport Washington-National Airport in Arlington County
- ❖ Shenandoah Valley Airport in Rockingham County (Served by US Airways Express)
- ❖ Hagerstown Regional Airport in Washington County, Maryland

Port and Intermodal Facilities:

- ❖ Virginia Inland Port- Warren County
 - On Route 522/ 340; 1.5 miles North of the I-66 Interchange.
 - This Intermodal terminal is a hub for truck container traffic to and from port, via rail. From the inland port trucks distribute truck containers to and from Northern Virginia, West Virginia, Maryland, Pennsylvania, and Ohio.

Railroads:

- ❖ Norfolk Southern and CSX Corporation
- ❖ Winchester & Western Railroad (Provide local service in Frederick and Winchester)

Taxes

- ❖ Companies pay either county or city taxes.
- ❖ Towns provide additional community services over those available, as well as tax assessment for those in unincorporated areas of the counties.
- ❖ Water and sewer service rates outside town limits are generally higher.
- ❖ Nominal real estate rates per \$100 of assessed value for 2004 are listed for general comparison.
- ❖ Real estate is assessed at fair market value.
- ❖ Assessment methods for Personal Property and Machinery and Tools depend upon the jurisdiction.
- ❖ Tax rates in the Northern Shenandoah Valley tend to be lower than other areas of Virginia offering comparable services.
- ❖ Differences in rates reflect differing levels of services and tax base.

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Table IV-14. Tax Year 2004: Nominal Rates per \$100 Assessed Value			
Jurisdiction	Real Estate	Personal Property	Machinery & Tools
Clarke Co.	.74	4.00	1.25
Berryville	.20*	1.00*	.88*
Boyce	.05*	.60*	.60*
Frederick Co.	.73	4.20	2.00
Middletown	.065*	1.25*	N/A
Stephens City	.075*	1.00*	.50*
Page Co.	.67	3.00	2.00
Luray	.26*	.40*	.40*
Shenandoah	.28*	.33*	.33*
Stanley	.16*	.45*	.45*
Shenandoah Co.	.68	2.86	2.86
Edinburg	.185*	.75*	.75*
Mt. Jackson	.15*	.75*	.75*
New Market	.15*	.80*	.80*
Strasburg	.22*	1.11*	.86*
Toms Brook	.10*	.50*	N/A
Woodstock	.19*	.90*	.90*
Warren Co.	.76	3.15	2.25
Front Royal	.13*	.60*	.60*
City of Winchester	.69	3.50	1.20
* Add-On taxes.			

Industries and Major Employers

Table IV-15. Industries and Major Employers by Jurisdiction		
Industrial Sector as of June 30, 2004	Number of Employers	Number of Employed
Agricultural, Forestry, and Fisheries	72	518
Mining	N/A	N/A
Contract Construction	848	5,873
Manufacturing	229	17,914
Utilities	10	202
Information	77	1,035
Transportation and Communication	179	2,919
Trade	1,056	14,199
<i>Wholesale Trade</i>	211	2,615
<i>Retail Trade</i>	845	11,584
Finance, Insurance, and Real Estate	445	2,933
Services	2,114	27,519
Government	246	10,921
NSV Regional Commission	5,276	84,033
Source: Virginia Employment Commission, Quarterly Report Ending on June 30, 2004		

Major Employers:

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Major employers include all employers that, on average, have more than 100 employees on staff at all time. The three categories that these employers principally encompass are manufacturing, services, and retail trade. Employers are grouped into ranges as shown in Table IV-16.

Table IV-16. Major Employers	
1500-Above	1000-1499
Valley Health System	Wal-Mart Associates
Frederick County School Board	Rubbermaid Inc.
Lear Operations Corp. Automotive Industries	Shenandoah County School Board
	Georges Chicken LLC
800-999	600-799
George's Foods	Winchester City Public Schools
Kohl's Corporation	Grafton School Inc.
Perry Judds Inc.	Berryville Graphics Inc.
Warren County School Board	Federal Mogul Products Inc.
Food Lion Inc.	American Woodmark Corp.
400-599	
Page County School Board	Family Dollar Services Inc.
GE Lighting LLC	Poly One
National Fruit Product Co. Inc.	Clarke County School Board
Kraft Food Inc.	Lord Fairfax Community College
Kohl's Corporation	Shenandoah University
Shockey Brothers Inc.	Worldwide Automotive Inc.
* The information provided is based off Virginia Employment Commission (VEC) Source Data and was from "The Listing of Employer Accounts for 2nd Quarter 2003" released in March, 2004	

Section V. Hazard Identification and Risk Assessment

The Hazard Identification and Risk Assessment (HIRA) provides information to allow the regional commission and its member jurisdictions to better understand local hazards and the risks posed by such hazards, and to begin to develop mitigation strategies to lessen the impacts of these hazards. When developing this plan, every effort was made to gather input from all of the planning area communities to assure that the results of this analysis were as accurate as possible.

The planning area for this study includes five counties, one city and twelve incorporated towns. All jurisdictions located within these counties have been included in this portion of the study, as this analysis has been completed on a regional basis. It should be noted, however, that a local jurisdiction's inclusion in the complete hazard mitigation plan is dependent on the community's participation in the remainder of the planning process.

The purpose of the HIRA is to:

1. Identify what hazards could affect the Northern Shenandoah Valley
2. Profile hazard events and determine what areas and community assets are the most vulnerable to damage from these hazards
3. Estimate losses and prioritize the potential risks to the community

The first step, hazard identification, identifies all the natural hazards that might affect the planning area. The hazards are ranked to determine what hazards are most likely to impact the communities of NSVRC. The hazards that are determined to have significant impact are analyzed in the greatest detail to determine the magnitude of future events and the vulnerability of the community and its critical facilities. Hazards that receive a moderate or limited impact ranking are analyzed at a less detailed level consistent with risk, available data and vulnerability methodology.

Planning Area Description

The area served by the Northern Shenandoah Valley Regional Commission is located in the northern tip of Virginia, west of the Washington, DC, metropolitan area. The region is made up of Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock. Table V-1 and Figure V-1 illustrate the land area of each of the communities in the PDC as well as the populations in the communities and number of households. This information is a key component in determining the risk to communities from natural hazards.

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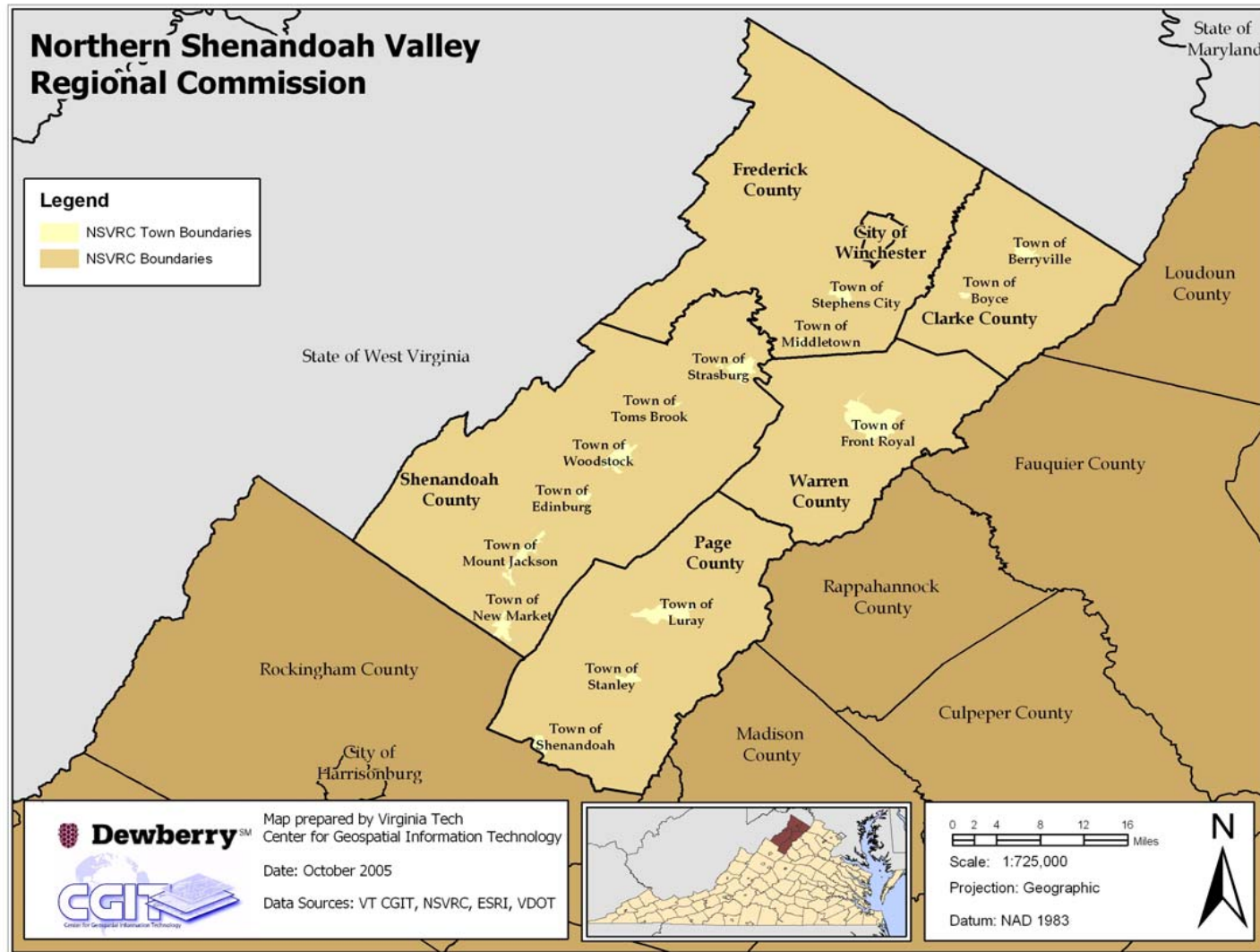


Figure V-1. Northern Shenandoah Valley Regional Commission Boundaries

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**Table V-1. Northern Shenandoah Valley Regional Commission Demographics
(from US Census Bureau)**

Name	Area (Sq Mile)	1990 Pop	2000 Pop	2000 Pop per Sq Mile	2004 Pop	Median Home Value	Total Housing Units
Clarke County	178.07	12,101	12,652	71	13,852	\$139,500	5,388
<i>Town of Berryville</i>	<i>1.35</i>	<i>3,097</i>	<i>2,963</i>	<i>2,195</i>	<i>3,110</i>	<i>\$116,700</i>	<i>1,312</i>
<i>Town of Boyce</i>	<i>0.34</i>	<i>520</i>	<i>426</i>	<i>1,253</i>	<i>446</i>	<i>\$105,000</i>	<i>168</i>
Frederick County	415.78	45,723	59,209	142	66,611	\$118,300	23,319
<i>Town of Middletown</i>	<i>0.6</i>	<i>1,061</i>	<i>1,015</i>	<i>1,692</i>	<i>1,078</i>	<i>\$93,200</i>	<i>432</i>
<i>Town of Stephens City</i>	<i>1.44</i>	<i>1,186</i>	<i>1,146</i>	<i>796</i>	<i>1,222</i>	<i>\$89,800</i>	<i>546</i>
Page County	314.09	21,690	23,177	74	23,730	\$86,300	10,557
<i>Town of Luray</i>	<i>4.86</i>	<i>4,587</i>	<i>4,871</i>	<i>1,002</i>	<i>4,878</i>	<i>\$87,700</i>	<i>2,191</i>
<i>Town of Stanley</i>	<i>1.19</i>	<i>1,186</i>	<i>1,326</i>	<i>1,114</i>	<i>1,335</i>	<i>\$82,900</i>	<i>598</i>
<i>Town of Shenandoah</i>	<i>1.38</i>	<i>2,213</i>	<i>1,878</i>	<i>1,361</i>	<i>1,877</i>	<i>\$80,700</i>	<i>812</i>
Shenandoah County	512.53	31,636	35,075	68	38,032	\$99,400	16,709
<i>Town of Edinburg</i>	<i>0.7</i>	<i>860</i>	<i>813</i>	<i>1,161</i>	<i>845</i>	<i>\$94,800</i>	<i>425</i>
<i>Town of Mount Jackson</i>	<i>1.22</i>	<i>1,583</i>	<i>1,664</i>	<i>1,364</i>	<i>1,732</i>	<i>\$87,299</i>	<i>717</i>
<i>Town of New Market</i>	<i>1.51</i>	<i>1,435</i>	<i>1,637</i>	<i>1,084</i>	<i>1,798</i>	<i>\$117,000</i>	<i>808</i>
<i>Town of Woodstock</i>	<i>2.74</i>	<i>3,182</i>	<i>3,952</i>	<i>1,442</i>	<i>4,153</i>	<i>\$111,900</i>	<i>1,840</i>
<i>Town of Strasburg</i>	<i>2.01</i>	<i>3,762</i>	<i>4,017</i>	<i>1,999</i>	<i>4,188</i>	<i>\$91,000</i>	<i>1,877</i>
<i>Town of Toms Brook</i>	<i>0.16</i>	<i>227</i>	<i>255</i>	<i>1,594</i>	<i>264</i>	<i>\$82,400</i>	<i>103</i>
Warren County	216.31	26,142	31,584	146	34,377	\$108,800	13,299
<i>Town of Front Royal</i>	<i>9.05</i>	<i>11,880</i>	<i>13,589</i>	<i>1,502</i>	<i>14,210</i>	<i>\$100,500</i>	<i>5,752</i>
City of Winchester	9.34	21,947	23,585	2,525	24,779	\$108,900	10,587

Watersheds

The major watershed for the region is the Potomac River Basin. The Rappahannock River Basin borders the eastern side of the planning area while the James River Basin borders the southern portion of the region. Figure V-2 illustrates the location of the major watershed boundaries for the planning district.

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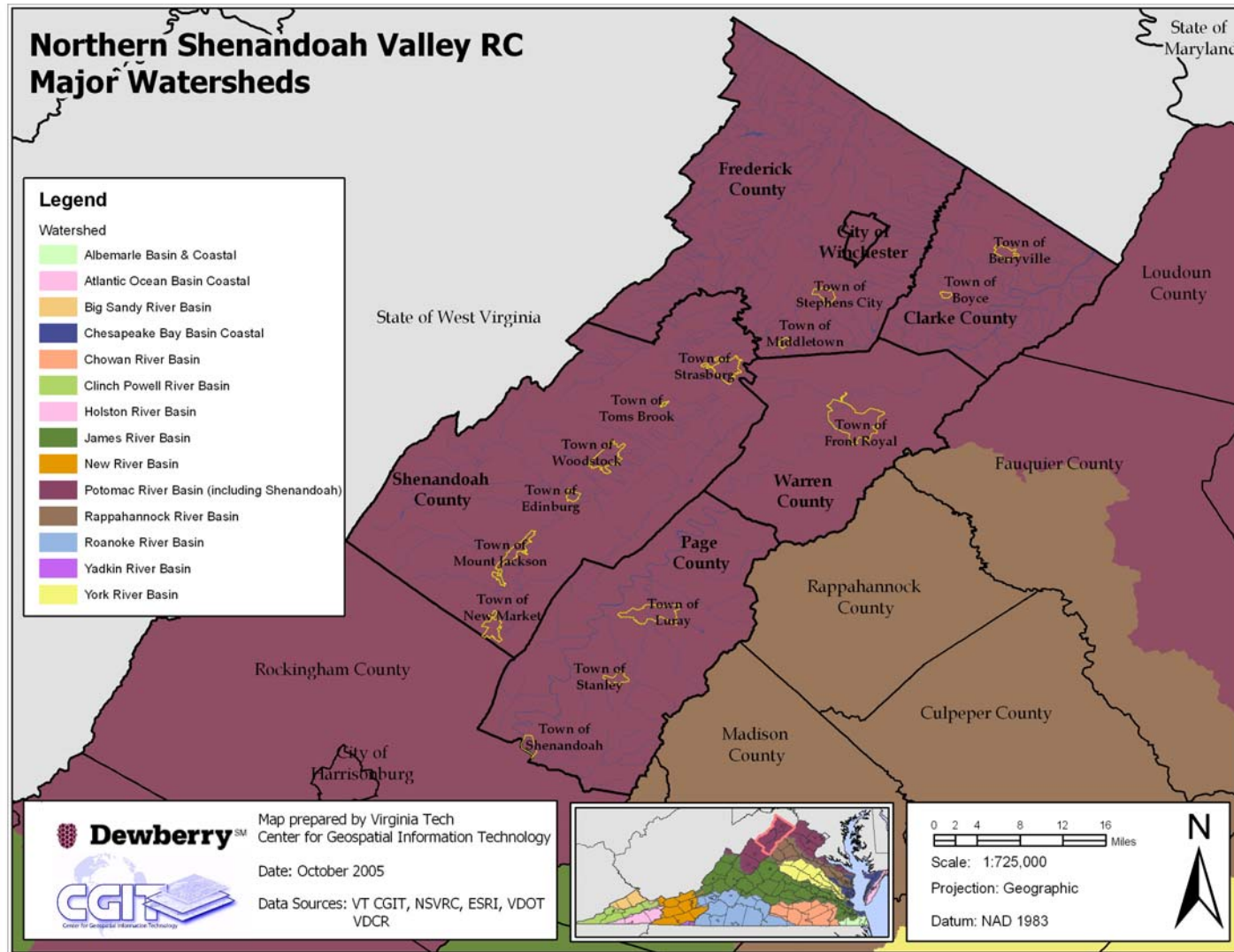


Figure V-2. NSVRC Watersheds

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Critical Facilities

According to FEMA State and Local Plan Interim Criteria, a critical facility is defined as a facility, in either the public or private sector, that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the jurisdiction, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Critical facilities for the NSVRC were derived from a variety of sources. Information provided by the Northern Shenandoah Valley Regional Commission was supplemented with ESRI data as well as geocoded facilities completed by the Virginia Tech Center for Geospatial Information Technology (CGIT). Critical facilities include fire/rescue stations, police stations, government/administrative centers, schools, and churches. Figure V-3 shows the locations of critical facilities in the region. A large percentage of the region's critical facilities are located within town and city boundaries, since most of the population lives within or in close proximity to the region's towns and the City of Winchester.

Analysis for the region was completed using the best available data. Census blocks were used to assess the area's vulnerability to specific hazards such as winter storm and wind. The flooding analysis was conducted primarily using floodplain, tax parcel and building footprint data provided by the communities and NSVRC. For some communities, structure points were determined using Virginia Base Mapping imagery, which was then intersected with the floodplain data for the region. Structure value was established using average house value in the 2000 Census data. The 2000 Census data for average structure value per block was used as a replacement cost in the event of a disaster. This value can serve as a guide in assessing the impacts of various hazards.

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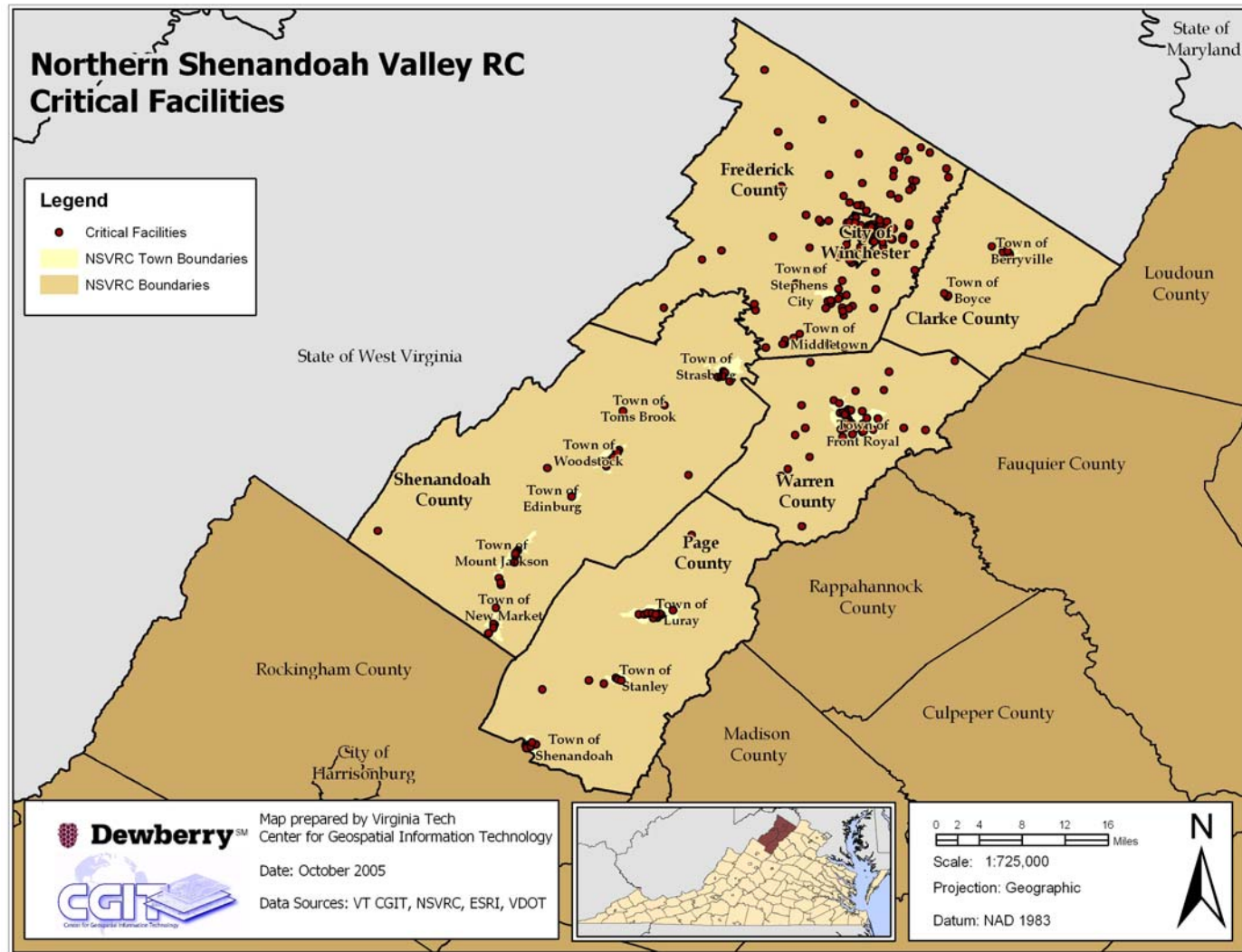


Figure V-3. Critical Facilities in Northern Shenandoah

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Data Limitations

Inadequate information posed a problem for developing loss estimates for most of the identified hazards. The primary limiting factor was that the hazard mapping precision is at only a relatively large scale (i.e., the county or jurisdiction level) as opposed to precision at a smaller scale such as census block or parcel. In addition, many of the hazards, such as winter storm and wildfire, do not have defined damage estimate criteria, limiting the ability to perform a quantitative loss estimate.

The FEMA guidelines emphasize using “best available” data for this plan. A variety of methodologies were used based on the type of data that was available. The Northern Shenandoah Valley Regional Commission and member jurisdictions provided available base map data including tax parcels, zoning, street mapping and some utilities, building footprints (where available), and critical facility information. All other data were derived from existing sources or created by the Virginia Tech Center for Geospatial Information Technology.

Critical facilities, residential and industrial buildings within the 100 year floodplain were identified for quantitative damage analysis. The Hazards US – Multi-Hazard (HAZUS-MH) model was used to estimate dollar damages from hurricanes in the Northern Shenandoah Valley region.

Hazard Identification

Types of Hazards

Although any type of disaster is possible for any given area in the United States, the most likely hazards that could potentially affect the communities in the Northern Shenandoah Valley Regional Commission, based on past incidence and the knowledge of the Mitigation Advisory Committee, include:

- Droughts
- Flooding
- Hurricanes
- Land Subsidence
- Landslides
- Tornadoes
- Wildfires
- Winter Storms

The Mitigation Steering Committee also wanted to include a qualitative assessment of the man-made or human-caused hazards that could affect the planning area. The human-caused hazards included in this plan are:

- Hazardous Material Spills

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- Pipelines
- Mass Evacuation from Northern Virginia

Hazard Ranking

Hazards were ranked by the Mitigation Steering Committee to determine what hazards they judged to have the largest impact on their communities. The results are summarized in Table V-2.

Table V-2. Northern Shenandoah Planning Consideration Levels	
Hazard Type	Planning Consideration
Natural	
Winter Storm/Extreme Cold	Significant
Flooding	Moderate
Wildfire	Moderate
Drought/Extreme Heat	Limited
High Wind/Hurricane	Limited
Land Subsidence (Karst)	Limited
Landslide/Steep Slopes	Limited
Tornado/Hail	Limited
Earthquake	<i>None</i>
Human-Caused	
Hazardous Material Spills	Limited
Pipelines	Limited
Mass Evacuation from Northern Virginia	Limited

Additional areas of impact and areas of concern were noted by the committee members through a problem spot worksheet, and on paper maps of the region. Each locality was given an opportunity to provide input, to the best of their ability, in determining what areas were concerns or “problems” in their communities. The areas indicated by the committee members and the public were taken into consideration during the analysis phase. Individual community problem spot maps were developed for Warren and Shenandoah Counties (Appendix B).

Major Disasters

Appendix C lists the major disasters that have occurred in the planning area over the past seventy-five years, including Presidentially-declared disasters. Communities in the Northern Shenandoah Valley have received 12 Presidential Disaster Declarations since 1972.

Level of Hazard

Table V-3 provides information on the types of analysis and data used for each of the hazards addressed in this plan. The level of planning consideration given to each hazard was

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determined by the committee members. Based on the input of committee members at the kick-off meeting, the hazards were broken into four distinct categories (Significant, Moderate, Limited, or None) which represent the level of consideration they will receive throughout the planning process.

In order to focus on the most critical hazards that may affect the Planning District communities, hazards assigned a level of *Significant* or *Moderate* received the most extensive attention in the remainder of the planning analysis, while those with a *Limited* planning consideration level were assessed in more general terms.

Earthquake, with a planning level of *None*, is not addressed in this plan. Although earthquakes are not critical enough to warrant further evaluation, this should not be interpreted as having zero probability or impact. An earthquake is the shaking of the ground's surface caused by movements of the plates beneath it. Though there have been historical occurrences of earthquakes that have affected the area, the probability and impact is low enough for the overall risk to be considered "none" at a planning level. This reasoning is supported by an earthquake loss estimate created using FEMA's HAZUS-MH that shows annualized earthquake losses for the region of \$488,000. This number is compared to annualized losses from wind events of \$815,886.

Additional areas of impact were noted by the committee members through a problem spot worksheet, and on paper maps of the region. The areas that the committee members indicated were taken into consideration during the analysis phase.

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Table V-3. Northern Shenandoah Hazards HIRA Overview

Hazard	Type	Detail Level	Analysis Level	Data Reference
Natural				
Winter Storm/ Extreme Cold	Including winter storms, ice storms, and excessive cold	Significant	Covered by HIRA blizzards/winter storm analysis	NOAA National Weather Service Records, VirginiaView PRISM
Flooding	Riverine	Moderate	Covered by HIRA flood analysis	FEMA DFIRM, Q3, and FIRM Mapping
Wildfire	Wildfire	Moderate	Covered by HIRA wildfire analysis	Virginia Department of Forestry (VDOF)
Drought/ Extreme Heat	Including excessive heat	Limited	Covered by HIRA drought analysis	Drought Monitor
High Wind/ Hurricane	Hurricane	Limited	Covered by HIRA hurricane analysis	FEMA DFIRM, Q3, and FIRM Mapping and ASCE Design Wind Speed Maps, FEMA HAZUS model
Land Subsidence	Karst	Limited	Description and Regional Maps	Virginia Department of Mine, Minerals and Energy (DMME), United State Geological Survey (USGS)
Landslide/Steep Slope	Landslide/Steep Slope	Limited	Description and Regional Maps	USGS
Tornado/ Hail	Tornado	Limited	Description and Regional Maps	NOAA National Weather Service Records
Earthquake	Earthquake	None	None, due to infrequency of occurrence	None
Human – Caused				
Hazardous materials Spills	Hazardous materials Spills	Limited	Description	FEMA
Pipelines	Pipelines	Limited	Description	FEMA
Mass Evacuation from Northern Virginia	Mass Evacuation from Northern Virginia	Limited	Description	EOPs, VDOT

Severe Winter Storm (Significant Ranking)

Hazard Profile

Primary Impacts

The impacts of winter storms are minimal in terms of property damage and long-term effects. The most notable impact from winter storms is the damage to power distribution networks and utilities. Severe winter storms have the potential to inhibit normal functions of the community. Governmental costs for this type of event are a result of the personnel and

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equipment needed for clearing streets. Private sector losses are attributed to lost work and lost sales when employees and customers are unable to travel. Homes and businesses suffer damage when electric service is interrupted for long periods of time. Health threats can become severe when frozen precipitation makes roadways and walkways very slippery, when there are prolonged power outages, or if fuel supplies are jeopardized. Occasionally, buildings may be damaged when snow loads exceed the design capacity of their roofs or when trees fall due to excessive ice accumulation on branches. The primary impact of excessive cold is increased potential for frostbite and potentially death as a result of over-exposure to extreme cold.

Secondary Effects

Some of the secondary effects presented by winter weather and extreme cold are danger to livestock and pets, and frozen water pipes in homes and businesses.

Predictability and Frequency

Winter storms can consist of a combination of heavy snowfall, high winds, ice and extreme cold. Winter weather typically impacts the state of Virginia between the months of November and April, with varied intensities from east to west. In order to create a statewide winter weather hazard potential map that captures this variability, gridded climate data was obtained from the Climate Source and through the VirginiaView program. The data was developed by the Oregon State University Spatial Climate Analysis Service (SCAS) using PRISM (Parameter-elevation Regressions on Independent Slopes Model). This climate mapping system is an analytical tool that uses point weather station observation data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters.

The winter weather risk assessment in this plan uses monthly normal precipitation, mean annual days with snowfall greater than 1 inch, and mean monthly snowfall PRISM data to develop snow and ice potential maps for the state, which are then extrapolated to the planning area. These datasets have been generated to incorporate topographic effects on precipitation, capture orographic rain shadows, and include coastal and lake effect influences on precipitation and snowfall. The monthly precipitation grid provides a 30-year climatological average of total precipitation in inches. The mean monthly snowfall grid provides a 30-year climatological average depth of freshly fallen snow in inches. The mean annual days map reveals the 30-year average of the number of days that a location will receive greater than 1 inch of snowfall in a 24-hour period in a given year.

A criterion of greater than 1 inch was selected for winter snowfall severity assessment because this depth will result in complete road coverage that can create extremely dangerous

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driving conditions and will require removal by the local community. This amount of snowfall in a 24-hour period also can lead to business closure and school delays or cancellation. Figure V-4 shows the average number of days with snowfall greater than one inch for the state and Figure V-5 shows the same for the Northern Shenandoah region.

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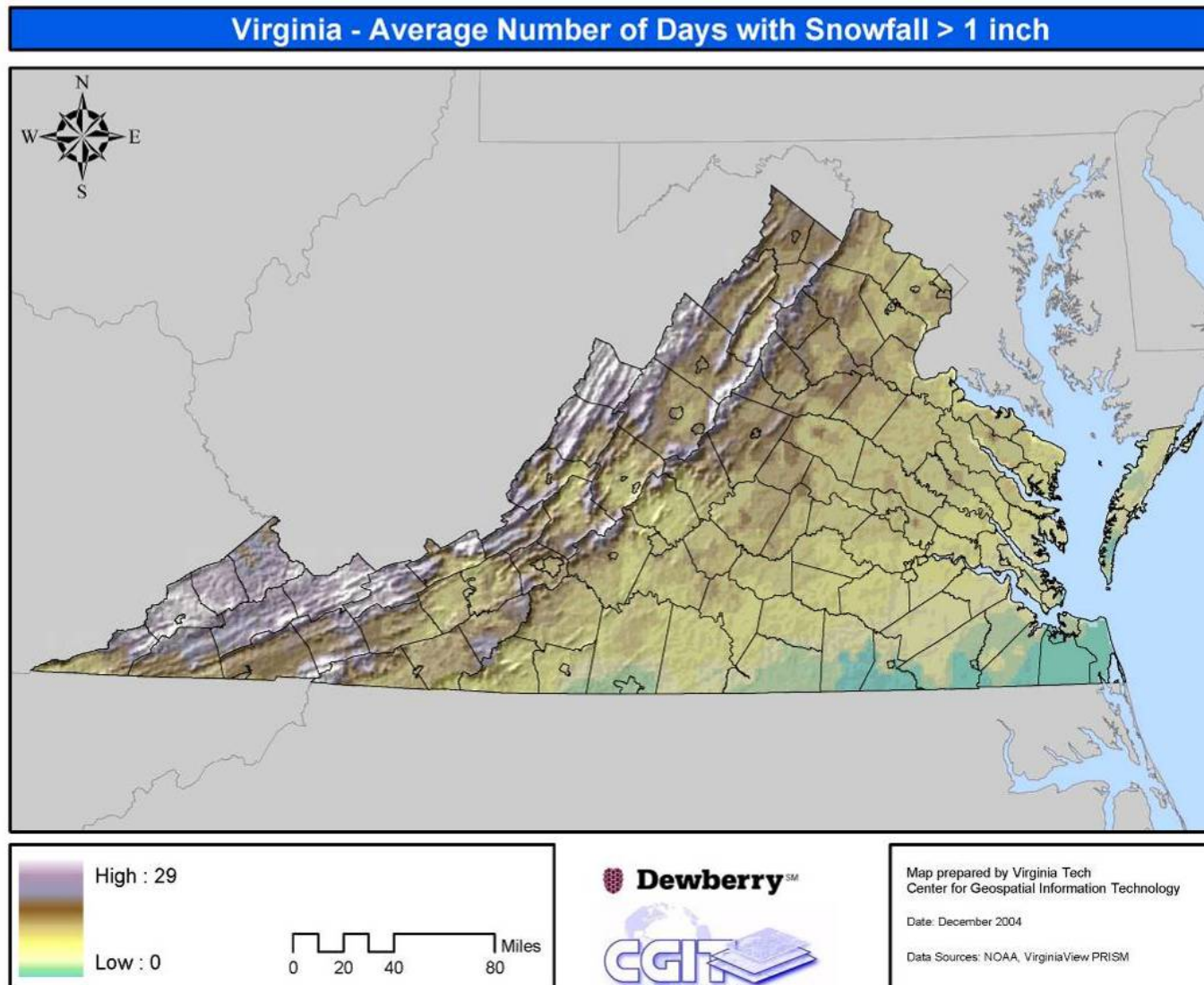


Figure V-4. Virginia Average Number of Days with Snowfall > 1 inch

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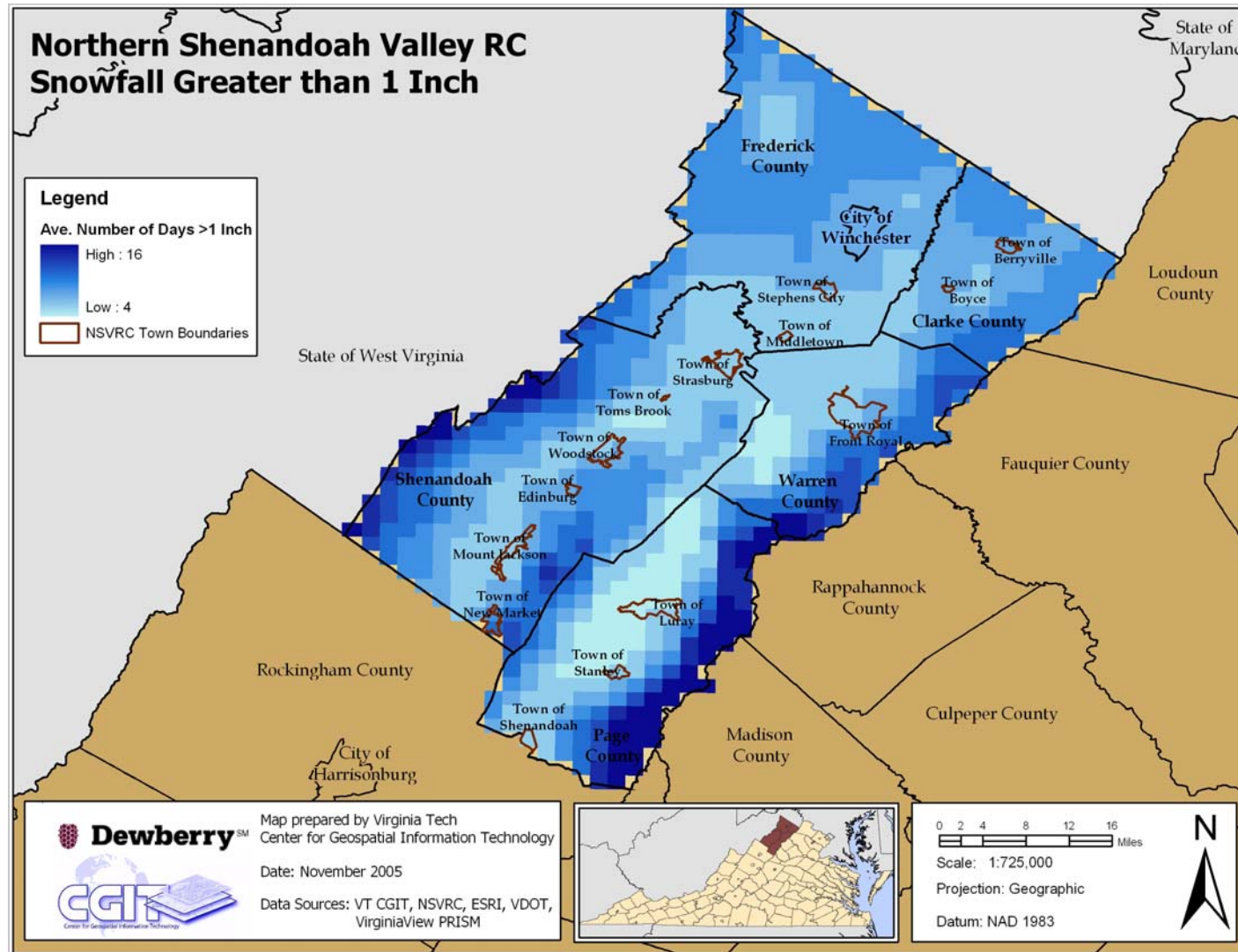


Figure V-5. Northern Shenandoah Average Number of Days with Snowfall > 1 inch

Ice Potential

Another challenge presented by winter weather in Virginia and the Northern Shenandoah Valley region is the amount of ice that often comes as part of winter weather. Snowfall and ice potential are generated based on the percentage difference between the total precipitation from November to April and the corresponding liquid equivalent snowfall depth. Since snowfall is in a frozen state, it does not accumulate on the surface the same way that liquid rainfall would. In order to account for this difference, characteristic snow/rain relationships have been created.

For example, a value of 1 would mean that all of the precipitation at the location falls as liquid rainfall, while a value of 0.5 would mean that half of the precipitation falls as liquid rainfall and half falls as frozen precipitation. It is assumed that the lower this percentage, the greater potential that precipitation within these months is falling as snow. The values in the middle of the two extremes would represent regions that favor ice conditions over rain and snow. A five quantile distribution was applied to the output statewide grid to split the percentages into five characteristic climatological winter weather categories (snow, snow/ice, ice, rain/ice, and rain).

Figure V-6 shows the statewide winter weather map and Figure V-7 shows the Northern Shenandoah Valley regional winter weather map. There is a small pocket of snow/ice mixture centered around the Town of Stanley and to the west of the Town of Luray. Ice potential is low throughout the Northern Shenandoah Valley because this region of the state has a drier climate from November to March and because mean daily temperatures hover around 32°F during this same time period. This combination of drier climate and colder temperatures makes it difficult for significant ice storms to develop in the region.

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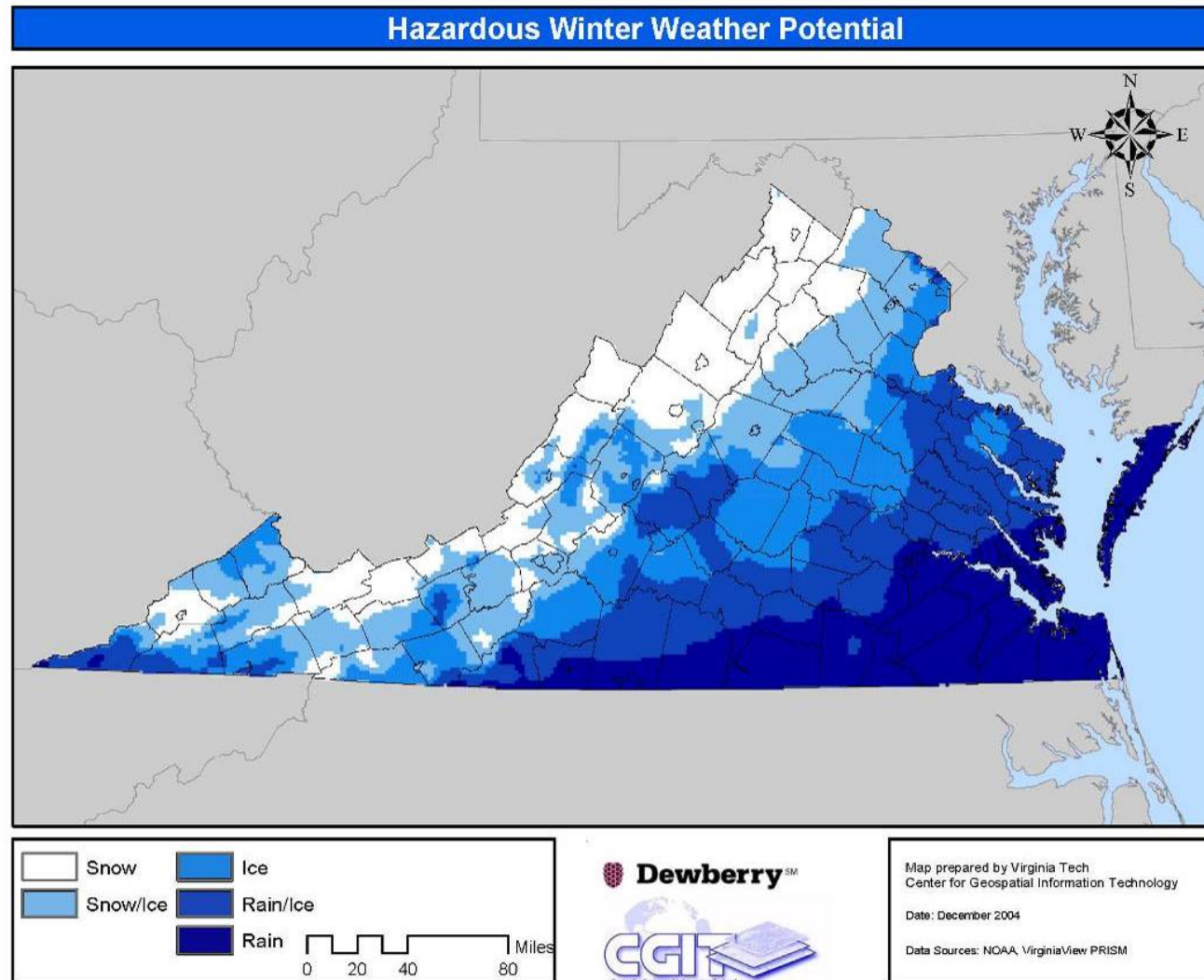


Figure V-6. Virginia Hazardous Winter Weather Potential Based on LEQ Precipitation

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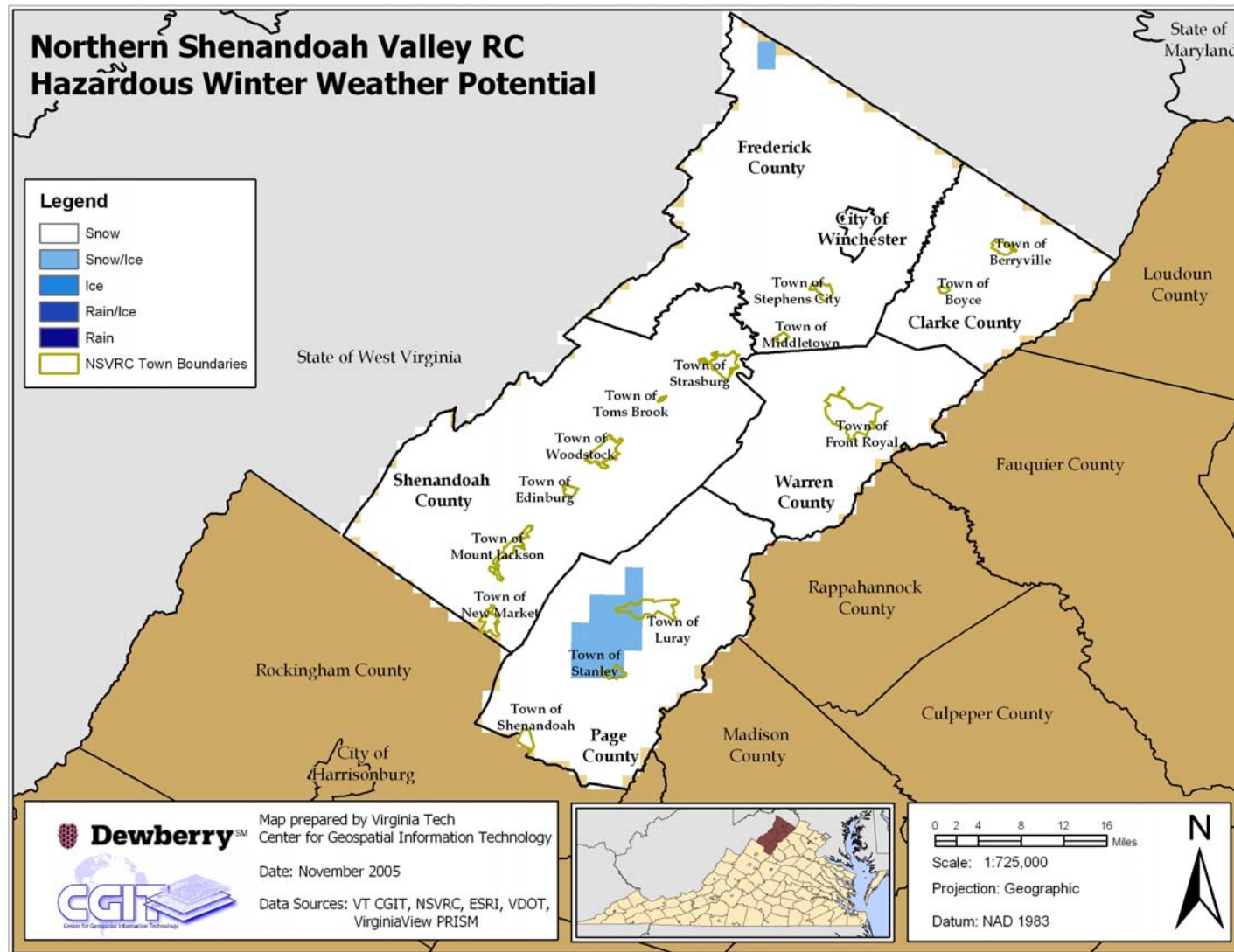


Figure V-7. Northern Shenandoah Hazardous Winter Weather Potential Based on LEQ Precipitation

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Hazard History

Appendix C includes descriptions of major winter storm events in the Northern Shenandoah region. Events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community-specific description is available, the general description represents the entire planning area.

Vulnerability Analysis

Figures V-5 and V-7 show the overall winter weather and ice potential for the Northern Shenandoah Valley region. Figures V-8 and V-9 show relative risk or vulnerability based on these previous maps. These were developed by assigning a high risk to those census blocks within the regions with the greatest potential for snowy days (> 1 inch of snow) or ice. Division into high, medium and low were based on the levels predicted from potential maps. Tables V-4 and V-5 show the population in each county impacted by the overall snowfall and ice risks. County totals include town subtotals. Future revision of this plan will need to develop a method to calculate the potential loss from these winter storms.

The winter weather mapping resolution does not support accurate town-based analysis, since most towns in Northern Shenandoah would be represented by one or two pixels at this resolution. As weather data has better spatial resolution in the future, the ability to create practical town-based analysis will be improved. Although Tables V-4 and V-5 show town-based vulnerability, the analysis method was designed to derive broad regional vulnerability comparisons, not pinpoint location comparisons. Also, the nature of winter storm preparedness and subsequent impact can not be represented with snow or ice potential maps. Even though Page County and the Towns of Shenandoah and Stanley may receive more snow than other localities, it is likely that more VDOT and power company resources are allocated to those areas to address winter weather.

Appendix D contains the zoom-in maps for relative snowfall potential for each of the localities in the region. Relative ice potential maps for the region were omitted due to the lack of variation throughout Northern Shenandoah. Ice potential may still be a concern for the localities, but as a relative risk, the region does not have a variation of vulnerability. The appendix contains a full size map for the region, followed by the subsequent locality maps.

General trends determined for the Northern Shenandoah Valley region include:

- Western portions of Frederick County have a moderate potential for snowfall in relation to the rest of the Northern Shenandoah Valley region because this part of the county is at a higher elevation and temperatures are colder. Eastern Frederick

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County and the City of Winchester have a lower potential for significant snowfall because they are at a much lower elevation and are typically warmer.

- Southern and eastern Clarke County falls within the moderate category for snowfall because of the higher elevation Shenandoah mountain range that exists within these areas, creating a colder climate.
- Eastern Warren County has a higher potential for snowfall than western Warren because the Shenandoah Mountains make up the eastern border of this county, causing lower temperatures.
- Central Shenandoah County has a low potential for snowfall because it is within the valley of the surrounding Shenandoah mountain ranges to the east and west. These two mountain ranges are what make the outer regions of this county fall into the moderate potential category.
- Southern Page County has the highest relative potential for snowfall because this region receives the most winter precipitation and is also at the higher elevations of the Shenandoah Mountains.

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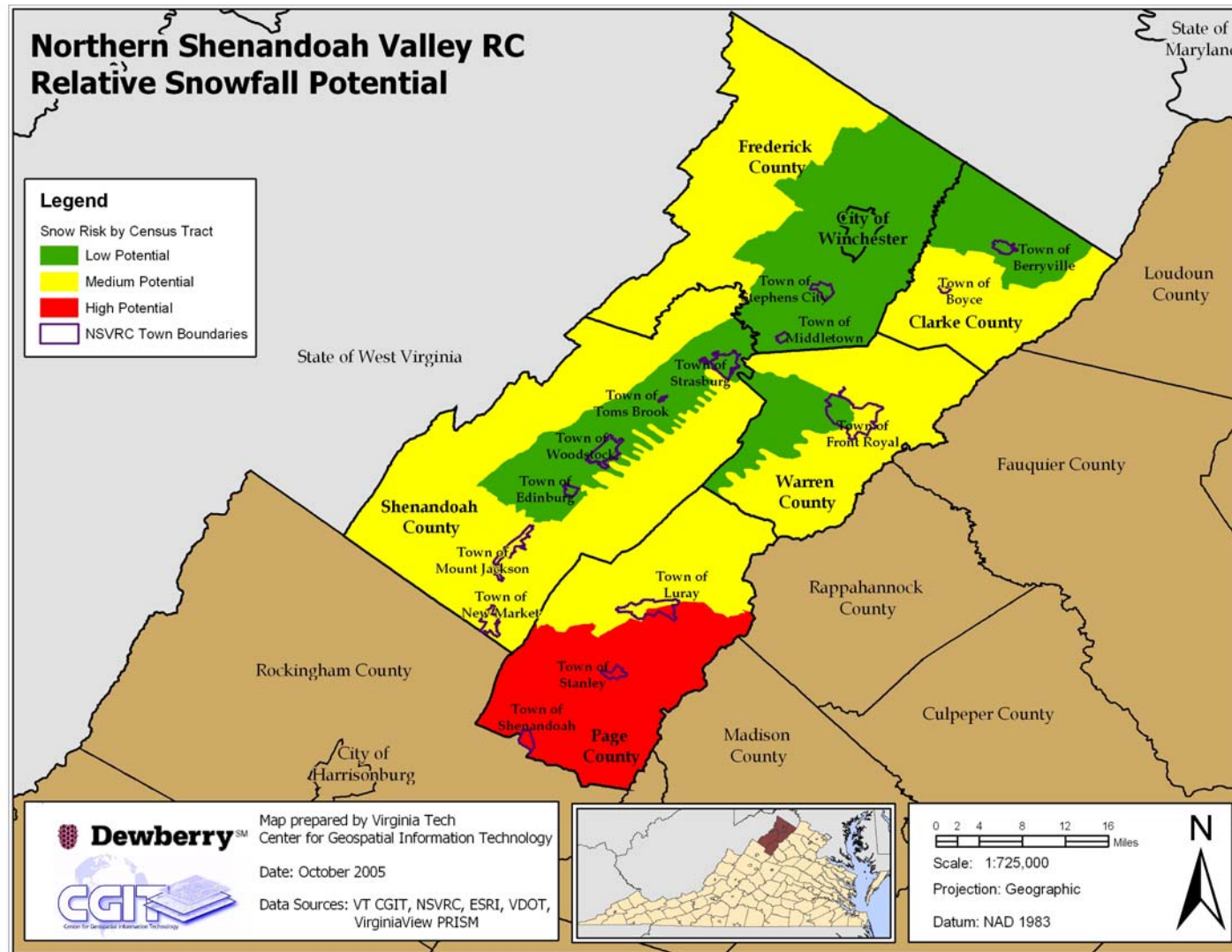


Figure V-8. Northern Shenandoah Snowfall Relative Risk.

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**Table V-4. Northern Shenandoah Population Snowfall Relative Risk
(from 2000 Census)**

Community	Low	Medium	High	Total
Clarke County	7196	5456	0	12,652
<i>*Town of Berryville</i>	<i>2,963</i>	<i>0</i>	<i>0</i>	<i>2,963</i>
<i>*Town of Boyce</i>	<i>0</i>	<i>426</i>	<i>0</i>	<i>426</i>
Frederick County	49,251	9,958	0	59,209
<i>*Town of Middletown</i>	<i>1,015</i>	<i>0</i>	<i>0</i>	<i>1,015</i>
<i>*Town of Stephens City</i>	<i>1,146</i>	<i>0</i>	<i>0</i>	<i>1,146</i>
Page County	0	6,583	16,594	23,177
<i>*Town of Luray</i>	<i>0</i>	<i>3,653</i>	<i>1,218</i>	<i>4,871</i>
<i>*Town of Stanley</i>	<i>0</i>	<i>0</i>	<i>1,326</i>	<i>1,326</i>
<i>*Town of Shenandoah</i>	<i>0</i>	<i>0</i>	<i>1,878</i>	<i>1,878</i>
Shenandoah County	20,933	14,142	0	35,075
<i>*Town of Edinburg</i>	<i>813</i>	<i>0</i>	<i>0</i>	<i>813</i>
<i>*Town of Mount Jackson</i>	<i>0</i>	<i>1,664</i>	<i>0</i>	<i>1,664</i>
<i>*Town of New Market</i>	<i>0</i>	<i>1,637</i>	<i>0</i>	<i>1,637</i>
<i>*Town of Woodstock</i>	<i>3,952</i>	<i>0</i>	<i>0</i>	<i>3,952</i>
<i>*Town of Strasburg</i>	<i>4,017</i>	<i>0</i>	<i>0</i>	<i>4,017</i>
<i>*Town of Toms Brook</i>	<i>255</i>	<i>0</i>	<i>0</i>	<i>255</i>
Warren County	15,014	16,570	0	31,584
<i>*Town of Front Royal</i>	<i>9,293</i>	<i>4,296</i>	<i>0</i>	<i>13,589</i>
City of Winchester	23,585	0	0	23,585
*Denotes town values that are also included in totals for the respective county				

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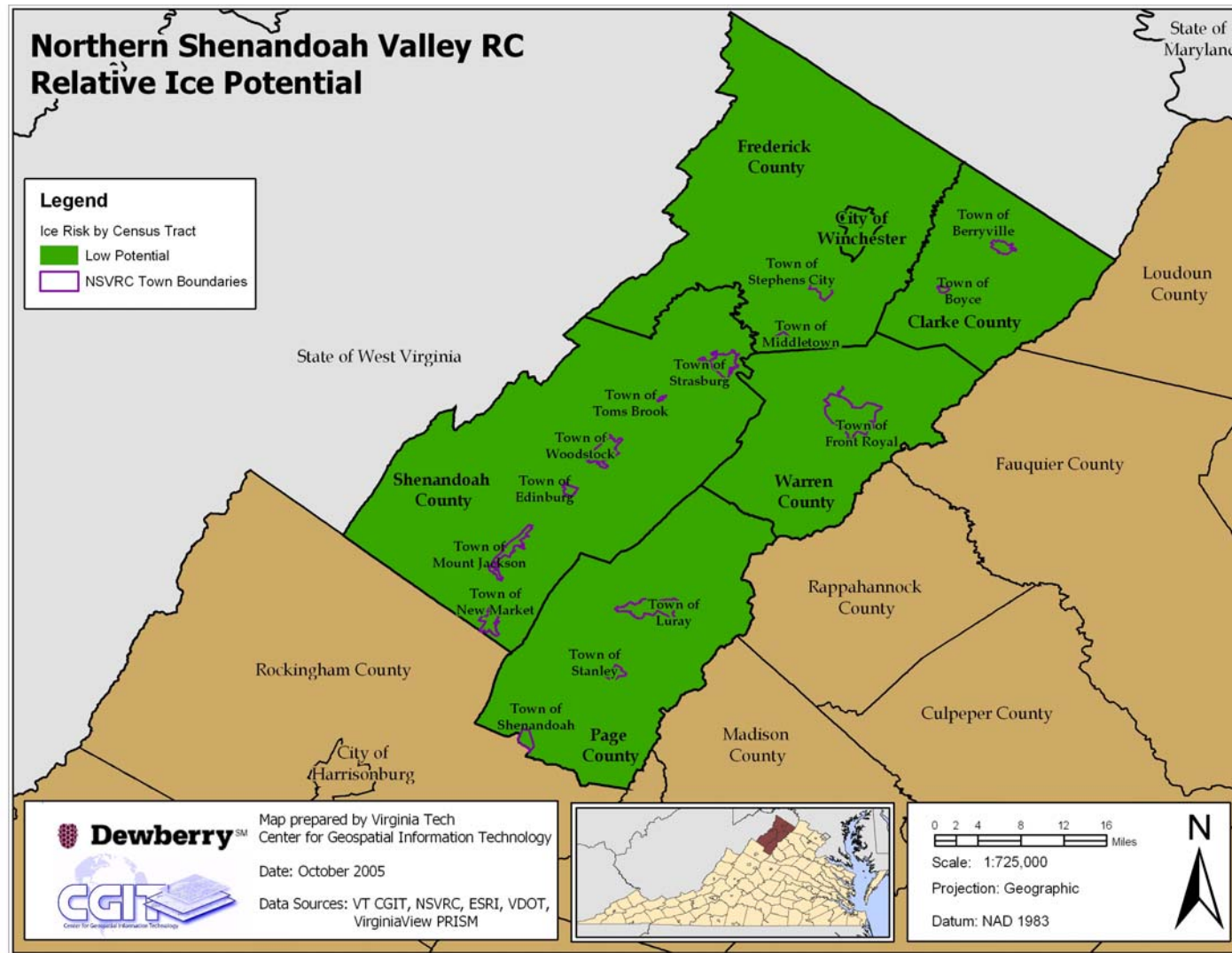


Figure V-9. Northern Shenandoah Ice Relative Risk

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Table V-5. Northern Shenandoah Population Ice Relative Risk (from 2000 Census)

Community	Low	Medium	High	TOTAL
Clarke County	12,652	0	0	12,652
<i>*Town of Berryville</i>	<i>2,963</i>	0	0	<i>2,963</i>
<i>*Town of Boyce</i>	<i>426</i>	0	0	<i>426</i>
Frederick County	59,209	0	0	59,209
<i>*Town of Middletown</i>	<i>1,015</i>	0	0	<i>1,015</i>
<i>*Town of Stephens City</i>	<i>1,146</i>	0	0	<i>1,146</i>
Page County	23,177	0	0	23,177
<i>*Town of Luray</i>	<i>4,871</i>	0	0	<i>4,871</i>
<i>*Town of Stanley</i>	<i>1,326</i>	0	0	<i>1,326</i>
<i>*Town of Shenandoah</i>	<i>1,878</i>	0	0	<i>1,878</i>
Shenandoah County	35,075	0	0	35,075
<i>*Town of Edinburg</i>	<i>813</i>	0	0	<i>813</i>
<i>*Town of Mount Jackson</i>	<i>1,664</i>	0	0	<i>1,664</i>
<i>*Town of New Market</i>	<i>1,637</i>	0	0	<i>1,637</i>
<i>*Town of Woodstock</i>	<i>3,952</i>	0	0	<i>3,952</i>
<i>*Town of Strasburg</i>	<i>4,017</i>	0	0	<i>4,017</i>
<i>*Town of Toms Brook</i>	<i>255</i>	0	0	<i>255</i>
Warren County	31,584	0	0	31,584
<i>*Town of Front Royal</i>	<i>13,589</i>	0	0	<i>13,589</i>
City of Winchester	23,585	0	0	23,585

*Denotes town values that are also included in totals for the respective county

Flooding (Moderate Ranking)

Hazard Profile

A flood occurs when an area that is normally dry becomes inundated with water. Floods may result from the overflow of surface waters, overflow of inland and tidal waters, or mudflows. Flooding can occur at any time of the year, with peak times in the late winter and early spring. Snowmelt and ice jam breakaway contribute to winter flooding, while seasonal rain patterns contribute to spring flooding. Torrential rains from hurricanes and tropical systems are more likely in late summer. Development of flood-prone areas tends to increase the frequency and degree of flooding.

Floods typically are characterized by frequency such as the “1%-annual chance flood,” commonly referred to as the “100-year” flood. While more frequent floods do occur, as well as larger events that have lower probabilities of occurrence, the 1%-percent annual chance flood is used for most regulatory and hazard identification purposes.

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Floods pick up chemicals, sewage and toxins from roads, factories, and farms. Property affected by the flood may be contaminated with hazardous materials. Debris from vegetation and man-made structures also may become hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, as well as initiate power outages.

Secondary Effects

Flooding can pose significant secondary impacts to the area where the event has taken place. Some of the impacts include infrastructure and utility failure, as well as impacts to roadways, water service and wastewater treatment. These impacts can affect the entire planning district, limiting the availability of emergency services in the impacted area.

Flood Maps

Detailed data was available, as “Q3 flood maps” exist for all of the counties in the planning area. The Q3 flood maps are digital versions of the FEMA paper Flood Insurance Rate Maps (FIRMs) that have been georectified and digitized. These maps were utilized to determine the risk and vulnerability of flooding in the planning area. Figure V-10 shows the extent of the mapped floodplain in the region. County, city and town-specific maps are included in Appendix D. It should be noted that no FEMA floodplain map exists for the town of Boyce; therefore maps for this town are not included.

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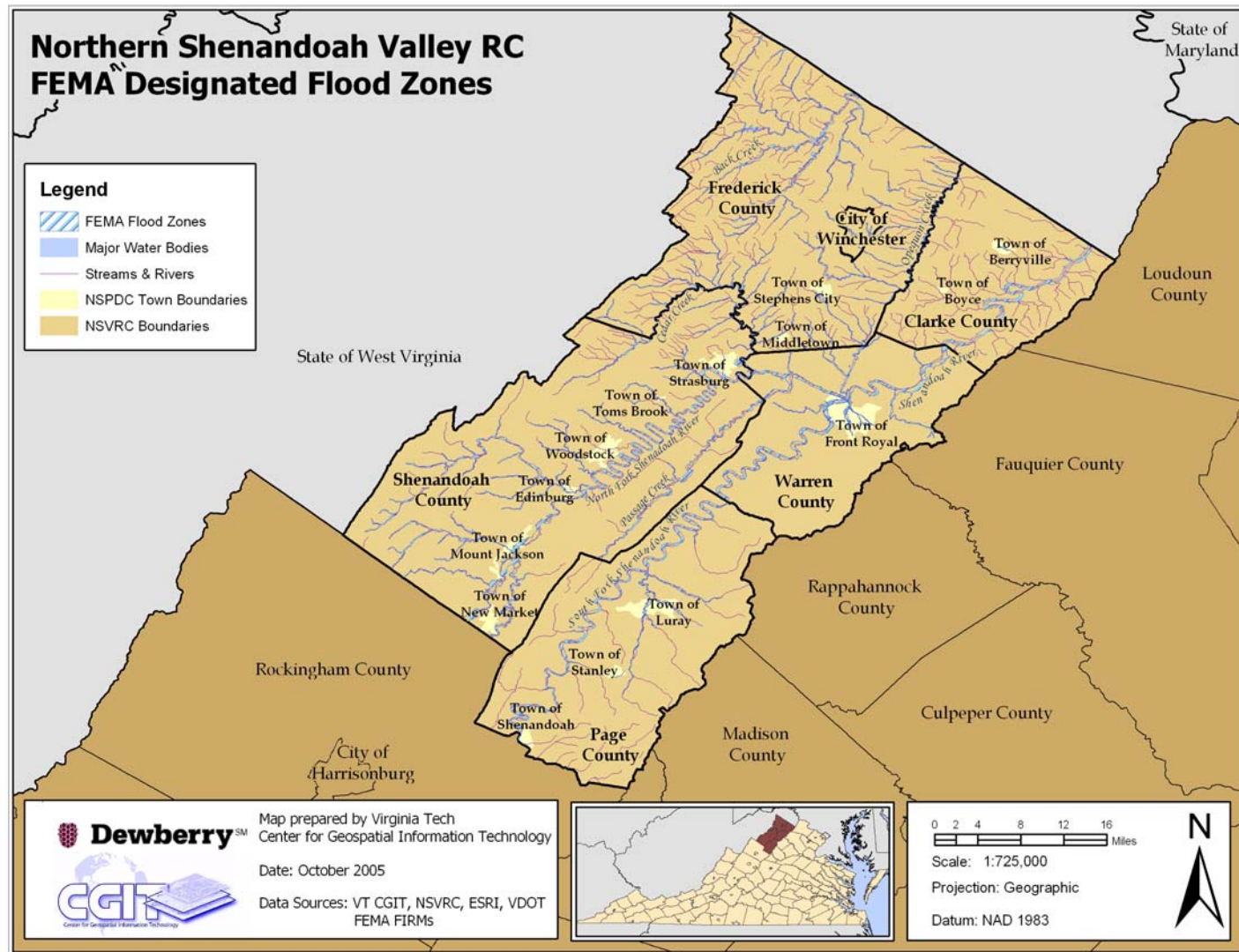


Figure V-10. Northern Shenandoah Floodplains

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Hazard History

Appendix C includes descriptions of major flood events in the Northern Shenandoah Region. Events have been categorized by the date of occurrence and where available, by individual community descriptions. When no community-specific description is available, the general description represents the entire planning area.

Vulnerability Analysis

Specific areas that are susceptible to flooding were determined by using the FEMA floodplain data and the information collected during the project kick-off meeting. Flooding in the region tends to be riverine in nature along the tributaries of the Shenandoah River. Localized flooding also can occur in the narrow valleys throughout the area and in the more urbanized areas where impervious surfaces exacerbate flood conditions. Flooding in the Northern Shenandoah Valley has some variation due to drainage areas. For many of the upland areas along the slopes of the Blue Ridge, there are steep narrow valleys that flood during localized precipitation events. This also applies to the City of Winchester, where a combination of small drainage areas and an undersized stormwater drainage system can cause localized flooding. For the towns in the region that are located along the North or South forks of the Shenandoah River, the flood warning time is slightly greater, but events like Hurricane Isabel can quickly cause flooding along the many meanders of the rivers.

Many factors contribute to the relative vulnerabilities of areas within the floodplain. Some of these factors include development or the presence of people and property in the floodplain, flood depth, flood velocity, elevation, construction type, and flood duration.

FEMA-Designated Repetitive Loss Properties

As of December 2003, there were 92 repetitive loss properties in the Northern Shenandoah Valley, with an average insurance loss payment of \$124,579 per structure (Appendix E). A majority of the repetitive loss structures in the region are single family homes, though the structures with the highest claims are non-residential. The total amount paid on the repetitive loss structures for the region is more than six million dollars. Shenandoah County has acquired seven of these properties and elevated one of these properties using FEMA grant funds.

Structures at Risk

The impact of flooding on structures was estimated based on best available data for floodplains and structures for each community. Table V-6 shows the sources for the structure values used for the flood loss analysis. The average structural value per census block from

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HAZUS-MH was used because the value information provided by the localities was not in a usable format for this analysis.

The impact of flooding on structures was estimated based best available data. For many communities, tax parcel databases provided the lot improvement value which related to the structural replacement value. When this data was not available, structure locations were directly digitized from the Virginia Base Mapping Project (VBMP) aerial photography completed in 2002, where individual buildings within the mapped floodplains or in the vicinity of the floodplain were denoted with a point location.

Table V-6. Northern Shenandoah Region Structural and Property Data Availability	
Community	Structural and Property Data
Clarke County	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of Berryville</i>	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Boyce</i>	No mapped floodplains.
Frederick County	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Middletown</i>	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Stephens City</i>	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
Page County	Digitized floodplain building locations from aerial photography. Average building value per census block from FEMA HAZUS-MH.
<i>*Town of Luray</i>	Digitized floodplain building locations from aerial photography. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Stanley</i>	Digitized floodplain building locations from aerial photography. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Shenandoah</i>	Digitized floodplain building locations from aerial photography. Average building value derived from HAZUS-MH census blocks.
Shenandoah County	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of Edinburg</i>	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of Mount Jackson</i>	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of New Market</i>	GIS building footprints without values. Building value from County tax parcel database.

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Table V-6. Northern Shenandoah Region Structural and Property Data Availability

Community	Structural and Property Data
<i>*Town of Woodstock</i>	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of Strasburg</i>	GIS building footprints without values. Building value from County tax parcel database.
<i>*Town of Toms Brook</i>	GIS building footprints without values. Building value from County tax parcel database.
Warren County	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
<i>*Town of Front Royal</i>	GIS building footprints without values. Average building value derived from HAZUS-MH census blocks.
City of Winchester	GIS building footprints without values; Building value from City tax parcel database.

The flood vulnerability was determined for each locality based on the intersection of floodplain map and the digitized point locations. This varied by community based on the available data. Table V-7 lists the total replacement value of structures vulnerable to flooding (both partially and entirely within the floodplain) in each community. These replacement values for structures were calculated as 10% greater when the HAZUS-MH census block average values were used. These values are likely to be underestimates, especially for any non-residential structures in the floodplain.

Table V-7. Structure Value Vulnerability

Community	Total Structure Value Vulnerability
Clarke County	\$34,127,040
<i>*Town of Berryville</i>	<i>\$12,190,820</i>
<i>*Town of Boyce</i>	<i>\$0</i>
Frederick County	\$125,412,880
<i>*Town of Middletown</i>	<i>\$1,198,890</i>
<i>*Town of Stephens City</i>	<i>\$540,210</i>
Page County	\$37,224,805
<i>*Town of Luray</i>	<i>\$19,469,120</i>
<i>*Town of Stanley</i>	<i>\$635,250</i>
<i>*Town of Shenandoah</i>	<i>\$178,200</i>
Shenandoah County	\$62,189,920
<i>*Town of Edinburg</i>	<i>\$4,183,000</i>
<i>*Town of Mount Jackson</i>	<i>\$667,400</i>
<i>*Town of New Market</i>	<i>\$0</i>

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Table V-7. Structure Value Vulnerability	
Community	Total Structure Value Vulnerability
<i>*Town of Woodstock</i>	<i>\$3,110,500</i>
<i>*Town of Strasburg</i>	<i>\$544,100</i>
<i>*Town of Toms Brook</i>	<i>\$228,900</i>
Warren County	\$198,541,650
<i>*Town of Front Royal</i>	<i>\$140,791,630</i>
City of Winchester	\$121,239,851
Total	\$578,736,146

**Denotes town values that are also included in totals for the respective county*

Estimating Losses

Using the property values from Table V-7, an estimate of the potential flood loss for each community was developed. Losses included structure and contents damage using a method based on FEMA Benefit-Cost Analysis. Contents values were estimated as 30% of the building value. Structural damage percentages were based on portion of the parcel or census block that was in the floodplain. Table V-8 shows how the basis for these damage percentages and how they were assigned depending on the mapping detail.

Table V-8. Flood Damage Classes				
Flood Damage Class	100-yr % Structural Damage	Representative Flood Depth Range	Mapped Parcels in Floodplain	Mapped Census Blocks in Floodplain
1	11%	0 to +1 ft	< 33%	< 33%
2	20%	+1 to + 3 ft	33% - 66%	33% - 66%
3	28%	> 3 ft	> 66 %	> 66 %

Contents damages were estimated as 50% greater than the structural damage percentage. These values were used to predict the damage from a 100-year flood event for the structure. To calculate an annualized flood damage estimate, it was assumed for each structure that damages begin with a 25-year event. A percentage of the 100-year flood damage value was used for events less frequent than the 100-year event.

For example, a parcel is determined to have a structure worth \$100,000 based on the HAZUS-MH census block average values. The replacement value of the structure would be \$110,000 and the contents value \$33,000. Based on the mapping analysis, it is determined that 45% of the parcel is in the floodplain. Using the classification scheme described above, the structure would be in Flood Damage Class 2, with 20% 100-year structure damage and the 30% contents damage. The damage from a 100-year flood would equal \$22,000 structural

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plus \$9,900 contents or a total of \$31,900. Figure V-11 shows the probability assumptions used to estimate the annualized loss at \$797.50.

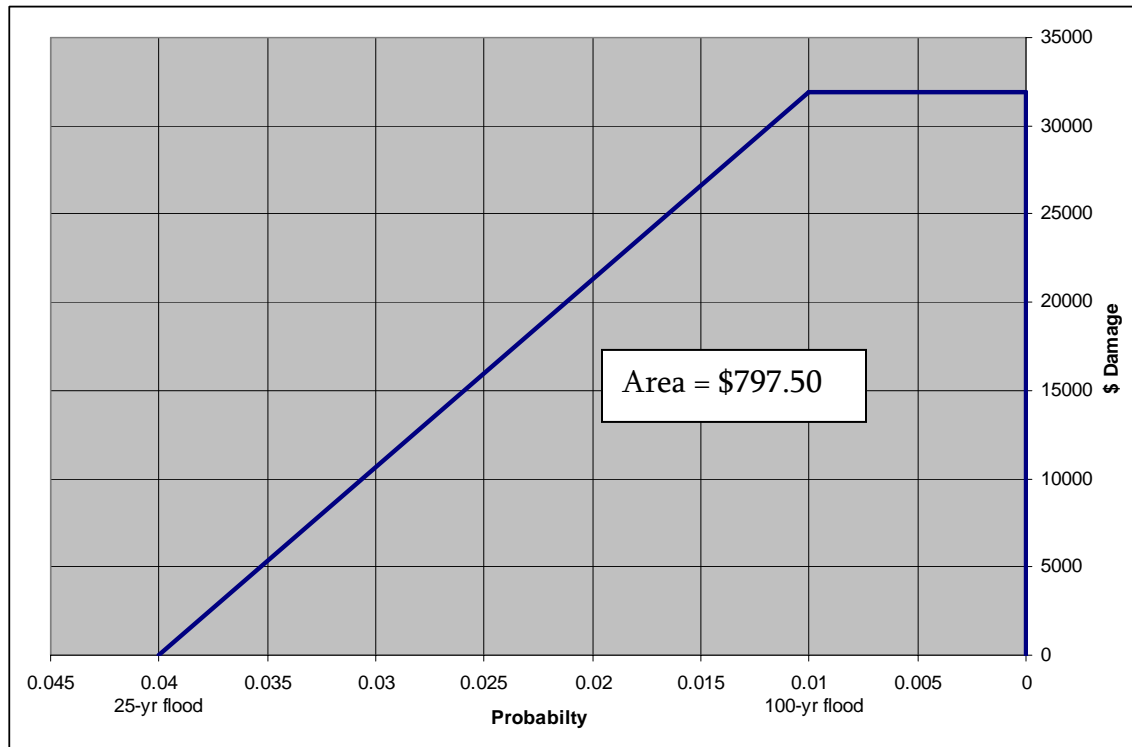


Figure V-11. Example of Flood Loss Estimate Technique

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Table V-9. Annualized Structure and Contents Loss Estimates	
Community	Total
Clarke County	\$264,606
<i>*Town of Berryville</i>	<i>\$97,608</i>
<i>*Town of Boyce</i>	<i>\$0</i>
Frederick County	\$1,107,120
<i>*Town of Middletown</i>	<i>\$10,458</i>
<i>*Town of Stephens City</i>	<i>\$4,868</i>
Page County	\$218,304
<i>*Town of Luray</i>	<i>\$126,549</i>
<i>*Town of Stanley</i>	<i>\$4,129</i>
<i>*Town of Shenandoah</i>	<i>\$1,158</i>
Shenandoah County	\$404,033
<i>*Town of Edinburg</i>	<i>\$26,988</i>
<i>*Town of Mount Jackson</i>	<i>\$4,338</i>
<i>*Town of New Market</i>	<i>\$0</i>
<i>*Town of Woodstock</i>	<i>\$20,218</i>
<i>*Town of Strasburg</i>	<i>\$3,537</i>
<i>*Town of Toms Brook</i>	<i>\$1,488</i>
Warren County	\$1,290,521
<i>*Town of Front Royal</i>	<i>\$915,146</i>
City of Winchester	\$853,189
Totals	\$4,137,773
*Denotes town values that are also included in totals for the respective county	

One limitation of this analysis method is that it underestimates the loss to higher-valued structures, such as businesses and critical facilities. When this method was used for these multi-million dollar structures, the loss estimates were unrealistic, since many of these structures in the vicinity of the floodplain may be elevated or have floodproofing measures in place which would reduce damages. Therefore, the maximum amount of damage for individual structures was capped at \$400,000 from a 100-year storm event (which translates into \$10,000 as an annualized loss). The values in Table V-10 reflect this assumption.

Figure V-12 shows the census blocks where these losses occur. Appendix D includes the individual jurisdiction maps and descriptions of problem spots identified by the MAC members. While most of the flood prone census blocks have less than \$20,000 annual flood losses, there are some locations with estimated losses over \$20,000. Table V-9 shows the annualized loss estimate for damage to structures and contents, broken down by community. Some of the highest losses are in the City of Winchester, and in the Towns of Berryville, Front Royal, and Luray.

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See Appendix B for figures and tables summarizing the problem spot locations that were denoted by the steering committee. These are areas of concern that were designated by the steering committee and public.

Appendix D contains the zoom-in maps for the annualized flood damages for each of the localities in the region. The appendix contains a full size map for the region, followed by the subsequent locality maps. It should be noted that no FEMA floodplain map exists for the town of Boyce and there was no annualized flood loss denoted for the town of New Market. Maps for these communities are not included in Appendix D.

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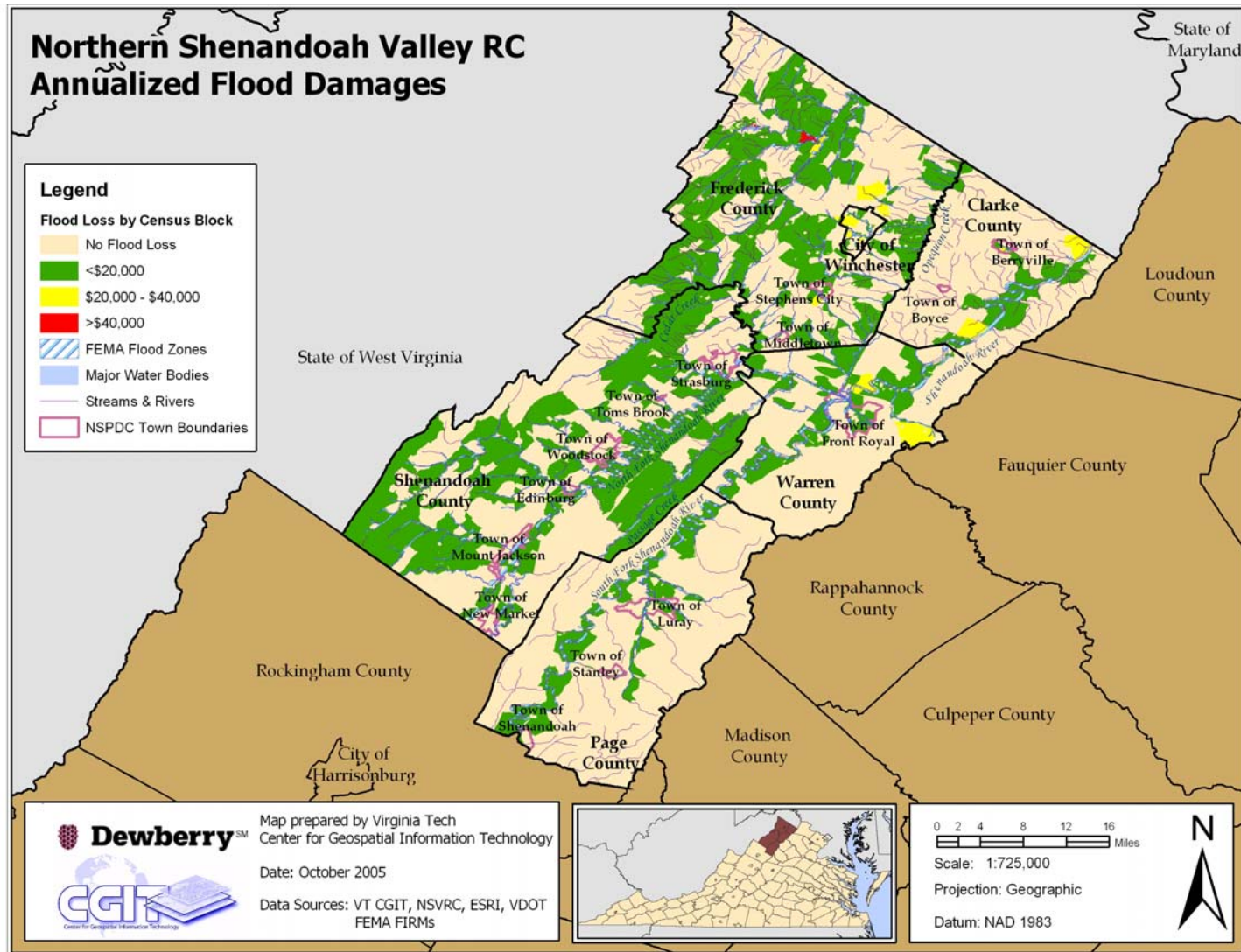


Figure V-12. Northern Shenandoah Annualized Flood Damages by Census Block.

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Critical Facilities

The impacts of flooding on critical facilities can significantly increase the overall effect of a flood event on a community. It should be noted that these facilities have been determined to be in the floodplain using Geographic Information Systems (GIS) and that this analysis should be used only as a planning tool. In order to accurately determine if a structure is actually in the floodplain, site-specific information must be available. Twenty-four critical facilities have been identified as being in the floodplain (Table V-10).

Table V-10. Critical Facilities in the Floodplain

Facility Name	Type	Jurisdiction
F&M Bank Educational Center	School	Town of Berryville (Clarke County)
Keystone Christian Academy	School	Town of Berryville (Clarke County)
Duncan Memorial United	Church	Town of Berryville (Clarke County)
New Hope Baptist Church	Church	Frederick County
Meadowbrook Freewill Baptist	Church	Town of Middletown (Frederick County)
Strasburg Public Works Facility	Government	Town of Strasburg (Shenandoah County)
Melkite Greek Catholic Church	Church	Warren County
Warren County Administration Building	Government	Town of Front Royal (Warren County)
Fire and Rescue	Fire & Rescue	Town of Front Royal (Warren County)
Dynamic Life Praise and Worship	Church	Town of Front Royal (Warren County)
Shenandoah University	School	City of Winchester
Winchester United Methodist	School	City of Winchester
Winchester City Sheriff	Police	City of Winchester
Winchester City Hall	Government	City of Winchester
Rouss Fire Company	Fire & Rescue	City of Winchester
Calvary Baptist Church	Church	City of Winchester
Celebration Fellowship	Church	City of Winchester
Christ Episcopal Church	Church	City of Winchester
First Presbyterian Church	Church	City of Winchester
Grace Evangelical Lutheran Church	Church	City of Winchester
John Mann United Methodist Church	Church	City of Winchester
Market Street United Methodist	Church	City of Winchester

Wildfire (Moderate Ranking)

Hazard Profile

Wildfire is a unique hazard in that it can be significantly altered based on efforts to control its course during the event. The Virginia Department of Forestry (VDOF) indicates that there are three principal factors that can lead to the formation of wildfire hazards: topography, fuel, and weather. The environmental conditions that exist during fire seasons exacerbate the hazard. When relative humidity is low and high winds are coupled with a dry forest floor (brush, grasses, leaf litter), wildfires may easily ignite. Years of drought can lead to environmental conditions that promote wildfires. Accidental or intentional setting of fires by humans is the largest contributor to wildfires. Residential areas or “woodland communities” that expand into wildland areas also increase the risk of wildfire threats.

Fire Seasons

Spring (March and April) and fall (October and November) are the two primary seasons for wildfires though they can occur year-round.

Secondary Effects

Secondary effects from wildfires can pose a significant threat to the communities surrounding the hazard. During a wildfire, the removal of groundcover that serves to stabilize soil can lead to hazards such as landslides, mudslides, and flooding. In addition, the leftover scorched and barren land may take years to recover and the resulting erosion can be problematic and extensive.

Hazard Areas

Figure V-13 shows the wildfire hazard map developed by VDOF. In 2002 and 2003, VDOF examined which factors influence the occurrence and advancement of wildfires and how these factors could be represented in a GIS model. VDOF determined that historical fire incidents, land cover (fuels surrogate), topographic characteristics, population density, and distance to roads were critical variables in a wildfire risk analysis. The resulting high, medium, and low risk category reflect the results of this analysis.

Hazard History

The Virginia Department of Forestry website provided fire incidence data for 1995 to 2001. The data provided by VDOF was summarized into the following tables. Table V-11 provides the breakdown of acres burned and the total amount of damage per county. Table V-12 illustrates the cause of fire, broken down by county. Twenty-seven percent (27%) of the fires

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in the Northern Shenandoah Valley region were caused by incendiary devices (e.g., fireworks), followed by 26% caused by debris burning.

Table V-11. Wildfire Summary 1995-2001 (VDOF)

Fire Year	1995		1996		1997		1998	
County	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage
Clarke County	2.1	\$150	774.6	\$147,800	10.9	\$3,200	5.3	\$1,675
Frederick County	13.5	\$51,900	11.2	\$1,550	18.4	\$32,660	51.2	\$7,320
Page County	1125.1	\$56,900	6.4	\$500	1009.7	\$35,000	210.8	\$200,000
Shenandoah County	25.8	\$140	14.9	\$2,520	21.4	\$1,300	16.5	\$910
Warren County	42.7	\$900	5	\$0	20.7	\$3,500	39.8	\$61,000
Total	1209.2	\$109,990	812.1	\$152,370	1081.1	\$75,660	323.6	\$270,905

Fire Year	1999		2000		2001		Acres Total	Damage Total
County	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage		
Clarke County	82.1	\$65,000	2.2	\$0	8.8	\$0	886	\$217,825
Frederick County	36.9	\$44,850	24.5	\$29,800	77.4	\$244,950	233.1	\$413,030
Page County	1031.2	\$27,500	1346	\$15,300	73.1	\$0	4802.3	\$335,200
Shenandoah County	296.5	\$19,130	25.3	\$12,490	63.6	\$1,620	464	\$38,110
Warren County	50.6	\$550	25.4	\$40	7	\$4,000	191.2	\$69,990
Total	1497.3	\$157,030	1423.4	\$57,630	229.9	\$250,570	6576.6	\$1,074,155

Table V-12. Wildfire Causes 1995-2001 (VDOF)

County	Lightning	Campfire	Smoking	Debris	Incendiary	Equip. Use	Railroad	Children	Misc.	Total
Clarke County	2	1	19	27	39	10	0	0	5	103
Frederick County	1	0	26	65	51	20	7	21	44	235
Page County	3	5	7	17	36	10	0	2	9	89
Shenandoah County	11	2	12	44	14	38	0	2	8	131
Warren County	3	2	19	31	57	9	0	14	22	157
Total	20	10	83	184	197	87	7	39	88	715

Vulnerability Analysis

Table V-13 illustrates the number of homes within woodland communities, as designated by Virginia Department of Forestry, in the Northern Shenandoah Valley region. In the region, 89% of the woodland homes fall into the high potential for a wildfire. This is an extremely high percentage, meaning almost all of the woodland homes are at a wildfire risk. Warren

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and Clarke Counties have the highest relative percentage of homes in areas of high wildfire potential, with 100% and 99% of homes in the highest risk category. Frederick County has the third highest relative risk for wildfire with 85% of woodland homes at risk.

Table V-14 provides a breakdown of the number of critical facilities in wildfire prone areas. Frederick County has a high percentage of critical facilities at risk (47%) followed by Warren County (29%). Overall, a relatively low number of critical facilities in the Northern Shenandoah Valley are at risk to wildfire (24%) events.

As Table V-15 illustrates, 59% of Warren County's population lives in areas classified as having high wildfire potential, followed by Frederick County with 52% of its population living in areas of high wildfire potential. Table V-15 is further supported with vulnerability to critical facilities in Table V-14; critical facilities in Frederick and Warren Counties have the highest percentage of critical facilities in the high wildfire potential category.

Table V-13. Number of Woodland Homes by Fire Rank					
County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Clarke County	0	13	1,001	1,014	99%
Frederick County	0	425	2,394	2,819	85%
Page County	0	265	346	611	57%
Shenandoah County	0	170	456	626	73%
Warren County	0	0	2,738	2,738	100%
Grand Total	0	873	6,935	7,808	89%

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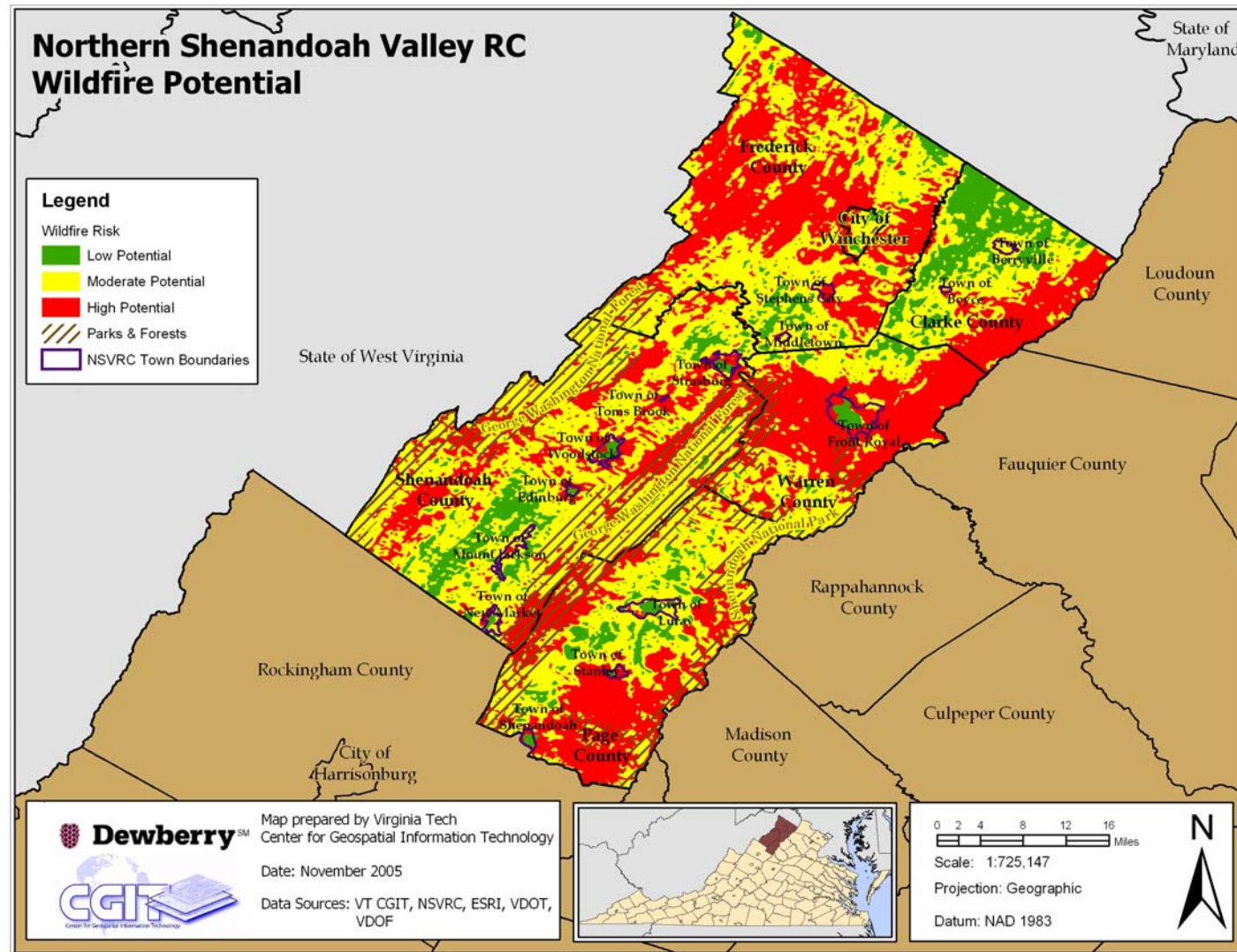


Figure V-13. Northern Shenandoah Wildfire Vulnerability

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Table V-14. Northern Shenandoah Critical Facilities Wildfire Vulnerability

Number of Critical Facilities by Fire Rank					
County	Low Potential	Medium Potential	High Potential	Total	% in High Potential
Clarke County	0	16	1	17	6%
Frederick County	4	48	46	98	47%
Page County	32	3	4	39	10%
Shenandoah County	29	15	6	50	12%
Warren County	33	7	16	56	29%
City of Winchester	27	30	6	63	10%
Total	125	119	79	323	24%

Table V-15. Northern Shenandoah Population Wildfire Vulnerability

Population by Fire Rank (US 1990 Census Block Group)					
County	Low Potential	Medium Potential	High Potential	Total	% in High Potential
Clarke County	4,023	5,855	2,775	12,652	22%
<i>*Town of Berryville</i>	0	2,149	948	3,097	31%
<i>*Town of Boyce</i>	173	173	173	520	33%
Frederick County	2,402	26,163	30,644	59,209	52%
<i>*Town of Middletown</i>	0	531	531	1,061	50%
<i>*Town of Stephens City</i>	0	722	464	1,186	39%
Page County	4,908	10,658	7,611	23,177	33%
<i>*Town of Luray</i>	2,211	1,310	1,067	4,587	23%
<i>*Town of Stanley</i>	326	422	438	1,186	37%
<i>*Town of Shenandoah</i>	953	474	786	2,213	36%
Shenandoah County	5,356	19,285	10,434	35,075	30%
<i>*Town of Edinburg</i>	215	336	436	987	44%
<i>*Town of Mount Jackson</i>	380	401	669	1,451	46%
<i>*Town of New Market</i>	414	414	572	1,400	41%
<i>*Town of Woodstock</i>	502	1,413	1,359	3,273	42%
<i>*Town of Strasburg</i>	1,175	980	3,762	5,917	64%
<i>*Town of Toms Brook</i>	0	0	227	227	100%
Warren County	8,286	4,786	18,511	31,584	59%
<i>*Town of Front Royal</i>	5,596	2,894	3,390	11,880	29%
City of Winchester	7,459	13,238	2,888	23,585	12%
Total	32,434	79,985	71,863	185,282	39%

*Denotes town values that are also included in totals for the respective county

Drought & Extreme Heat (Limited Ranking)

Hazard Profile

A drought can be characterized in several different ways depending on the impact. The most common form of drought is agricultural. Agricultural droughts are characterized by unusually dry conditions during the growing season. Meteorological drought is an extended period of time (i.e., six or more months) with precipitation less than 75 percent of the normal precipitation. The severity of droughts often depends on the community reliance on a specific water source. The probability of a drought is difficult to predict given the number of variables involved. As seen in Appendix C, drought conditions appear to make an appearance at least once a decade.

Many problems can arise after the onset of a drought, some of which include diminished water supplies and quality, livestock and wildlife becoming undernourished, crop damage, and possible wildfires. Secondary impacts from droughts pose problems to farmers with reductions in income, while food prices and lumber prices also could drastically increase.

The impact of extreme heat is most prevalent in urban areas, where urban heat island effects prevent inner-city buildings from releasing heat built up during the daylight hours. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts.

Table V-16 provides a summary of drought categories and impacts. Notice that water restrictions start off as voluntary and then become mandatory. For excessive heat, the National Weather Service utilizes heat index thresholds as criteria for the issuance of heat advisories and excessive heat warnings.

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Table V-16. Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions

Hazard History

Appendix C includes descriptions of major droughts that have occurred in the Northern Shenandoah. Events have been broken down by the date of occurrence and where available, by individual community descriptions. When no community specific description is available, the general description applies to the entire planning area.

Vulnerability Analysis

The 1990 Census contained detailed information about source of water per census block group. For purposes of this analysis, it was assumed that areas with less than 25% of the population with access to public/private water systems were assigned a high vulnerability ranking. When a drought occurs, these areas would likely feel a larger impact since most homes receive their water from wells, which may dry up during a drought. Table V-17 provides a summary of the 1990 population in three categories of drought vulnerability. Figures V-14 shows these categories for each of the jurisdictions in the region. Approximately 29% of the region is located in the highest vulnerability category, relying on water supplies that are vulnerable to drought. Page County has the highest vulnerable population percentage (40%), followed by Frederick County (35%). Towns have a considerably lower vulnerability to drought as a result of the various types of water supplies available. The vulnerability for a particular area may be understated because the analysis was completed on a census block scale. The presence of a water system that may serve a large population in a small geographic portion of the block may skew the ranking for that particular census block and make it appear as though a larger area is served by public water than what is actually served.

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Table V-17. Northern Shenandoah Population Drought Risk (from 1990 Census)

% Population with Public/ Private Water Systems	High (< 25%)	Medium (25% - 50%)	Low (> 50 %)	Total	% in High Vulnerability
Clarke County	3,850	3,232	5,019	12,101	32%
<i>*Town of Berryville</i>	0	0	3,097	3,097	0%
<i>*Town of Boyce</i>	0	520	0	520	0%
Frederick County	16,198	4,394	25,131	45,723	35%
<i>*Town of Middletown</i>	0	0	1,061	1,061	0%
<i>*Town of Stephens City</i>	0	0	1,186	1,186	0%
Page County	8,674	1,527	11,489	21,690	40%
<i>*Town of Luray</i>	0	0	4,587	4,587	0%
<i>*Town of Stanley</i>	0	0	1,186	1,186	0%
<i>*Town of Shenandoah</i>	0	0	2,213	2,213	0%
Shenandoah County	9,232	9,257	13,147	31,636	29%
<i>*Town of Edinburg</i>	0	0	860	860	0%
<i>*Town of Mount Jackson</i>	0	0	1,583	1,583	0%
<i>*Town of New Market</i>	0	700	735	1,435	0%
<i>*Town of Woodstock</i>	0	0	3,182	3,182	0%
<i>*Town of Strasburg</i>	0	1254	2,508	3,762	0%
<i>*Town of Toms Brook</i>	0	227	0	227	0%
Warren County	8,853	4,806	12,483	26,142	34%
<i>*Town of Front Royal</i>	0	0	11,880	11,880	0%
City of Winchester	0	0	21,947	21,947	0%
Total	46,807	23,216	89,216	159,239	29%

*Denotes town values that are also included in totals for the respective county

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

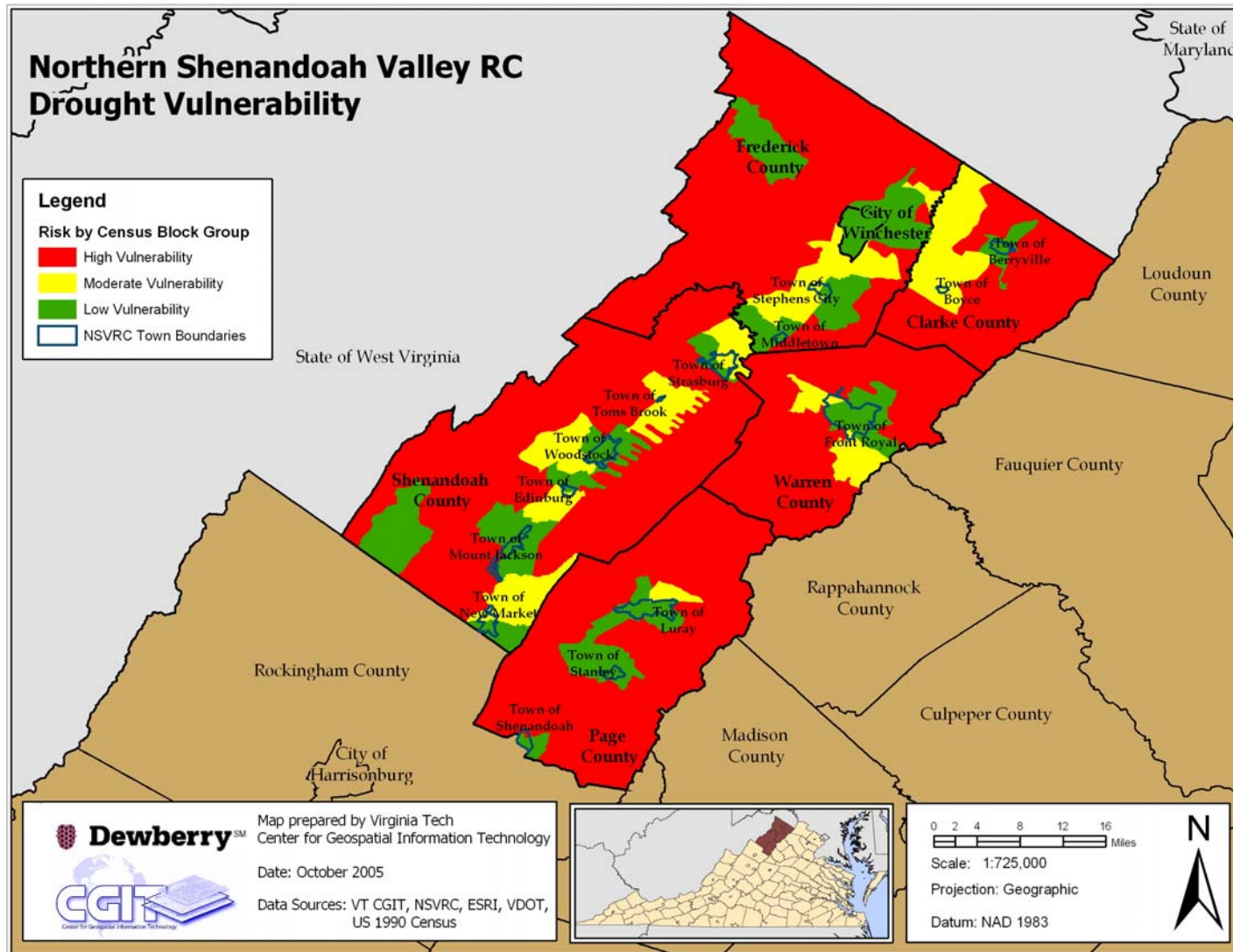


Figure V-14. Northern Shenandoah Drought Vulnerability

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Hurricane & High Wind (Limited)

Hazard Profile

A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. Depending on strength, tropical cyclones are classified as either hurricanes or tropical storms. Tropical cyclones involve both atmospheric and hydrologic characteristics, such as severe winds, storm, surge flooding, high waves, coastal erosion, extreme rainfall, thunderstorms, lightning, and, in some cases, tornadoes. High winds are associated with hurricanes, with two significant effects: widespread debris due to damaged and downed trees and damaged buildings; and power outages.

Once inland, the hurricane's band of thunderstorms produces torrential rains and, sometimes, tornadoes. A foot or more of rain may fall in less than a day, causing flash floods and mudslides. The rain eventually drains into the large rivers, which may still be flooding for days after the storm has passed. The storm's driving winds can topple trees, utility poles, and damage buildings. Communication and electricity may be lost for days and roads may be impassable due to fallen trees and debris.

Damaging winds typically are associated with tornadoes or land-falling hurricanes. Isolated “downburst” or “straight-line” winds associated with any common thunderstorm also can cause extensive property damage.

Hurricane Damage Scale

Hurricanes are categorized by the Saffir-Simpson Hurricane Damage Scale listed below (Table V-18). The table includes detailed descriptions of and the potential damage each category.

Table V-18. Saffir-Simpson Hurricane Damage Scale			
Hurricane Category	Sustained Winds (mph)	Damage Potential	Description
1	74 - 95	Minimal	Minimal damage to unanchored mobile homes along with shrubbery and trees. There may be pier damage and coastal road flooding, with storm surge 4-5 feet about average.
2	96 - 110	Moderate	Moderate damage potential to mobile homes and piers, as well as significant damage to shrubbery and trees with some damages to roofs, doors and windows. Impacts include flooding 2-4 hours before arrival of the hurricane in coastal and low lying areas. Storm surge can be 6-8 feet above average.

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Table V-18. Saffir-Simpson Hurricane Damage Scale

Hurricane Category	Sustained Winds (mph)	Damage Potential	Description
3	111 - 130	Extensive	Extensive damage potential. There will be structural damage to small residences and utility buildings. Extensive damage is to mobile homes and trees and shrubbery. Impacts include flooding 3-5 hours before the arrival of the hurricane cutting off the low lying escape routes. Coastal flooding has the potential to destroy the small structures, with significant damage to larger structures as a result of the floating debris. Land that is lower than 5 feet below mean sea level can be flooded 8 or more miles inland. Storm surge can be 6-12 feet above average.
4	131 - 155	Extreme	Extreme damage potential. Curtain wall failure as well as roof structure failure. Major damage to lower floors near the shoreline. Storm surge generally reaches 13-18 feet above average.
5	> 155	Catastrophic	Severe damage potential. Complete roof failure on residence and industrial structures, with complete destruction of mobile homes. All shrubs, trees and utility lines blown down. Storm surge is generally greater than 18 feet above average.

Hazard History

Appendix C includes descriptions of major hurricanes, thunderstorms, and high wind events in the Northern Shenandoah Valley region. Events have been categorized by the date of occurrence and where available, by individual community descriptions. When no community-specific description is available, the general description represents the entire planning area.

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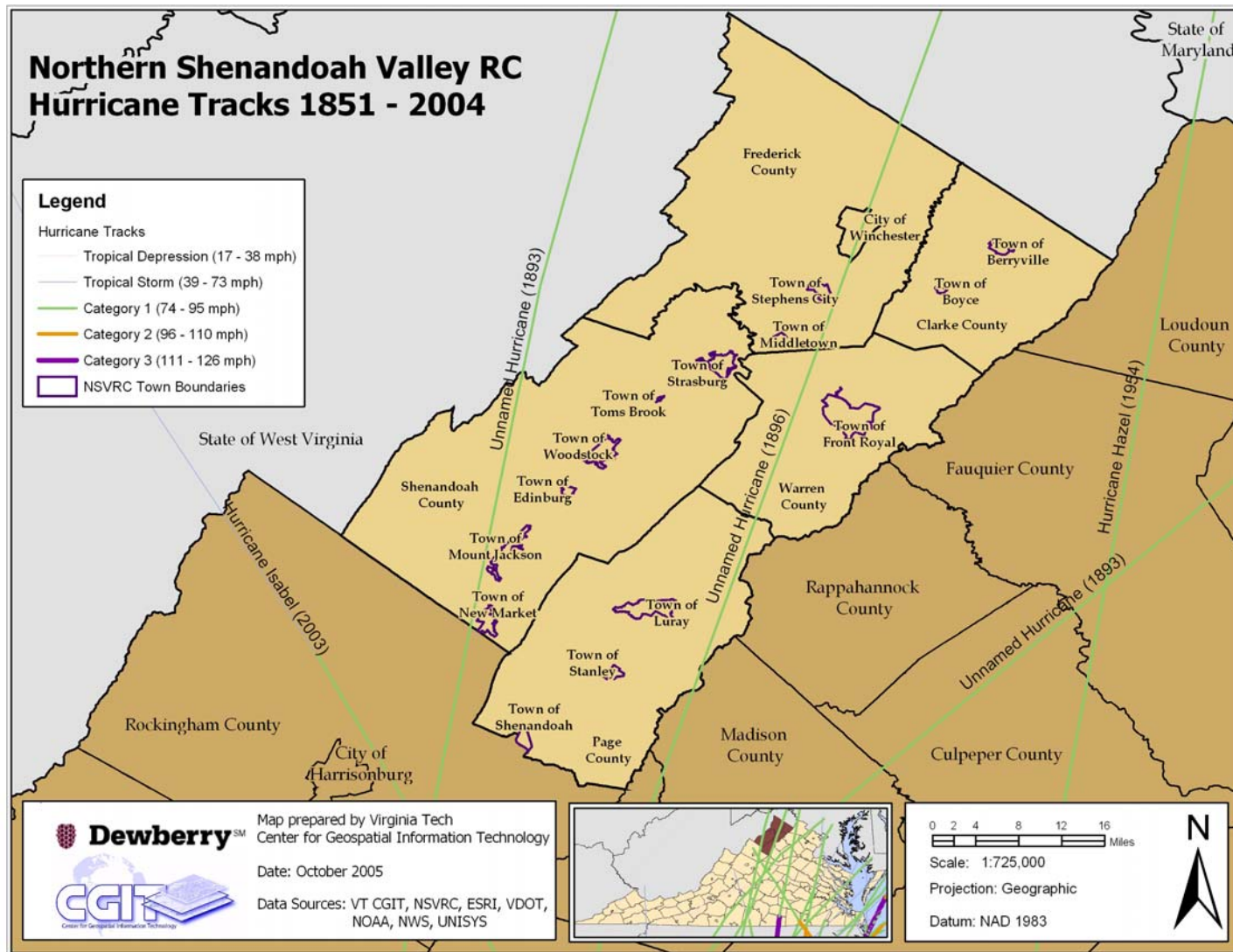


Figure V-15. Hurricane Tracks 1851 - 2004

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The Commonwealth of Virginia's Standard Hazard Mitigation Plan includes hurricane tracks in Virginia spanning from 1851 to 2004 (Figure V-15). The hurricane track map is a historical representation of occurrences in the Northern Shenandoah region. Two hurricanes are known to have tracked through the Northern Shenandoah Valley since 1851. In 1893, an unnamed hurricane tracked through Shenandoah County. In 1896, an unnamed hurricane tracked through the counties of Page, Warren, Frederick and the City of Winchester.

Hurricanes that have not tracked through the region still have had a considerable impact on the region. Notably, secondary impacts have caused loss of life, injury, property damage and widespread infrastructure damage (i.e. power and phone disruptions). An unnamed hurricane in 1893 tracked to the southeast of the region, as well as Hurricane Hazel in 1954. Hurricane Isabel in 2003 tracked to the southwest of the region in Rockingham County as a Category 1 hurricane and eventually weakened to a tropical storm.

Thunderstorms and high wind events are frequent in the Northern Shenandoah Valley, although most are localized events with little monetary damage. Appendix C provides detailed descriptions of past events.

Vulnerability Analysis

HAZUS-MH was used to complete the wind analysis for vulnerability and loss estimates. The HAZUS software has been developed by FEMA and the Nation Institute of Building Sciences. Level 1, with default parameters, was used for the analysis completed for in this plan. For analysis purposes, the U.S. Census tracks are the smallest extent in which the model runs. The results of this analysis are captured in the vulnerability analysis and loss estimation.

HAZUS-MH uses historical hurricane tracks and computer modeling to identify the probable tracks of a range of hurricane events. Appendix F includes the probabilistic wind speeds (50-, 100- and 1,000-year return period peak gust in miles per hour) predicted by the FEMA HAZUS-MH model for the Northern Shenandoah Valley region. As shown on the 50-year probabilistic wind event map, the northern portions of Frederick, Clarke and Warren Counties and City of Winchester are dominated by wind speeds less than 50 mph. The central and southern portions of the planning area are dominated by 50 to 60 mph winds. The 100-year probabilistic wind event map is uniform throughout the region with 60 to 70 mph winds. As with the 50-year wind event, the 1,000-year wind event follows the same trend, with 80 to 90 mph winds in the northern portions and 90 to 100 mph winds in the central and southern portions of the region. The impacts of these various events are combined to create a total annualized loss or the expected value of loss in any given year.

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Building Types

Table V-19 illustrates the probabilistic building stock exposure by building type. Information is based on Census 2000 data. For the Northern Shenandoah Valley region, wood-frame buildings account for a large percentage of the building stock (63%). Table V-20 illustrates the building stock exposure broken down by the type of occupancy. From the table, 84% of the building stock for the Northern Shenandoah Valley region is considered residential, and approximately 13% of the building stock is commercial and/or industrial. The smallest unit of analysis in the HAZUS-MH hurricane model is the U.S. Census tract level, which is larger than most of the towns in the region. Town exposure has been estimated as a percentage of the total housing units in the county. The county totals include the town subtotals. Differences in total exposure between Table V-19 and V-20 are a result of rounding in the FEMA HAZUS-MH software.

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Table V-19. Building Stock Exposure by Building Type (from HAZUS-MH)

Community	Wood	Masonry	Concrete	Steel	MH	Total
Clarke County	\$578,050.00	\$223,135.00	\$17,610.00	\$53,189.00	\$2,340.00	\$874,324.00
<i>*Town of Berryville</i>	<i>\$135,374.81</i>	<i>\$52,256.48</i>	<i>\$4,124.13</i>	<i>\$12,456.45</i>	<i>\$548.01</i>	<i>\$204,759.88</i>
<i>*Town of Boyce</i>	<i>\$19,463.27</i>	<i>\$7,513.08</i>	<i>\$592.94</i>	<i>\$1,790.90</i>	<i>\$78.79</i>	<i>\$29,438.98</i>
Frederick County	\$2,166,860.00	\$847,795.00	\$64,943.00	\$224,323.00	\$76,388.00	\$3,380,309.00
<i>*Town of Middletown</i>	<i>\$37,145.75</i>	<i>\$14,533.46</i>	<i>\$1,113.30</i>	<i>\$3,845.49</i>	<i>\$1,309.49</i>	<i>\$57,947.50</i>
<i>*Town of Stephens City</i>	<i>\$41,939.93</i>	<i>\$16,409.21</i>	<i>\$1,256.98</i>	<i>\$4,341.81</i>	<i>\$1,478.50</i>	<i>\$65,426.44</i>
Page County	\$889,633.00	\$347,719.00	\$29,089.00	\$83,453.00	\$42,447.00	\$1,392,341.00
<i>*Town of Luray</i>	<i>\$186,969.94</i>	<i>\$73,078.45</i>	<i>\$6,113.50</i>	<i>\$17,538.92</i>	<i>\$8,920.88</i>	<i>\$292,621.69</i>
<i>*Town of Stanley</i>	<i>\$50,897.59</i>	<i>\$19,893.66</i>	<i>\$1,664.24</i>	<i>\$4,774.50</i>	<i>\$2,428.47</i>	<i>\$79,658.46</i>
<i>*Town of Shenandoah</i>	<i>\$72,085.72</i>	<i>\$28,175.19</i>	<i>\$2,357.04</i>	<i>\$6,762.08</i>	<i>\$3,439.42</i>	<i>\$112,819.45</i>
Shenandoah County	\$1,531,930.00	\$625,151.00	\$64,553.00	\$202,988.00	\$27,513.00	\$2,452,135.00
<i>*Town of Edinburg</i>	<i>\$35,508.46</i>	<i>\$14,490.31</i>	<i>\$1,496.27</i>	<i>\$4,705.04</i>	<i>\$637.72</i>	<i>\$56,837.80</i>
<i>*Town of Mount Jackson</i>	<i>\$72,676.59</i>	<i>\$29,657.91</i>	<i>\$3,062.47</i>	<i>\$9,629.99</i>	<i>\$1,305.25</i>	<i>\$116,332.22</i>
<i>*Town of New Market</i>	<i>\$71,497.35</i>	<i>\$29,176.68</i>	<i>\$3,012.78</i>	<i>\$9,473.74</i>	<i>\$1,284.07</i>	<i>\$114,444.62</i>
<i>*Town of Woodstock</i>	<i>\$172,606.91</i>	<i>\$70,437.54</i>	<i>\$7,273.37</i>	<i>\$22,871.24</i>	<i>\$3,099.97</i>	<i>\$276,289.02</i>
<i>*Town of Strasburg</i>	<i>\$175,445.84</i>	<i>\$71,596.05</i>	<i>\$7,393.00</i>	<i>\$23,247.41</i>	<i>\$3,150.95</i>	<i>\$280,833.25</i>
<i>*Town of Toms Brook</i>	<i>\$11,137.34</i>	<i>\$4,544.93</i>	<i>\$469.31</i>	<i>\$1,475.75</i>	<i>\$200.02</i>	<i>\$17,827.35</i>
Warren County	\$1,280,157.00	\$497,712.00	\$40,685.00	\$114,682.00	\$16,071.00	\$1,949,307.00
<i>*Town of Front Royal</i>	<i>\$550,786.90</i>	<i>\$214,140.34</i>	<i>\$17,504.70</i>	<i>\$49,341.87</i>	<i>\$6,914.54</i>	<i>\$838,688.35</i>
City of Winchester	\$986,567.00	\$488,467.00	\$77,475.00	\$266,591.00	\$2,144.00	\$1,821,244.00
Total	\$7,433,197.00	\$3,029,979.00	\$294,355.00	\$945,226.00	\$166,903.00	\$11,869,660.00

All values are in thousands of dollars

**Denotes town values that are also included in totals for the respective county*

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Table V-20. Building Stock Exposure By General Occupancy (from HAZUS-MH)

Community	Residential	Commercial	Industrial	Agri.	Religion	Gov't	Ed.	Total
Clarke County	\$768,602.00	\$55,120.00	\$25,929.00	\$7,661.00	\$10,586.00	\$4,116.00	\$2,310.00	\$874,324.00
<i>*Town of Berryville</i>	<i>\$180,000.61</i>	<i>\$12,908.68</i>	<i>\$6,072.37</i>	<i>\$1,794.15</i>	<i>\$2,479.16</i>	<i>\$963.94</i>	<i>\$540.98</i>	<i>\$204,759.88</i>
<i>*Town of Boyce</i>	<i>\$25,879.26</i>	<i>\$1,855.92</i>	<i>\$873.04</i>	<i>\$257.95</i>	<i>\$356.44</i>	<i>\$138.59</i>	<i>\$77.78</i>	<i>\$29,438.98</i>
Frederick County	\$2,932,547.00	\$271,030.00	\$114,479.00	\$12,492.00	\$30,246.00	\$4,500.00	\$15,018.00	\$3,380,312.00
<i>*Town of Middletown</i>	<i>\$50,271.67</i>	<i>\$4,646.18</i>	<i>\$1,962.48</i>	<i>\$214.15</i>	<i>\$518.50</i>	<i>\$77.14</i>	<i>\$257.45</i>	<i>\$57,947.55</i>
<i>*Town of Stephens City</i>	<i>\$56,759.93</i>	<i>\$5,245.83</i>	<i>\$2,215.76</i>	<i>\$241.78</i>	<i>\$585.42</i>	<i>\$87.10</i>	<i>\$290.68</i>	<i>\$65,426.50</i>
Page County	\$1,220,026.00	\$108,146.00	\$24,780.00	\$8,816.00	\$21,470.00	\$3,420.00	\$5,690.00	\$1,392,348.00
<i>*Town of Luray</i>	<i>\$256,407.07</i>	<i>\$22,728.53</i>	<i>\$5,207.89</i>	<i>\$1,852.82</i>	<i>\$4,512.25</i>	<i>\$718.77</i>	<i>\$1,195.84</i>	<i>\$292,623.17</i>
<i>*Town of Stanley</i>	<i>\$69,799.99</i>	<i>\$6,187.24</i>	<i>\$1,417.71</i>	<i>\$504.38</i>	<i>\$1,228.34</i>	<i>\$195.66</i>	<i>\$325.54</i>	<i>\$79,658.86</i>
<i>*Town of Shenandoah</i>	<i>\$98,857.01</i>	<i>\$8,762.92</i>	<i>\$2,007.89</i>	<i>\$714.35</i>	<i>\$1,739.68</i>	<i>\$277.12</i>	<i>\$461.05</i>	<i>\$112,820.02</i>
Shenandoah County	\$2,060,377.00	\$217,589.00	\$85,609.00	\$8,182.00	\$26,146.00	\$16,798.00	\$37,433.00	\$2,452,134.00
<i>*Town of Edinburg</i>	<i>\$47,757.28</i>	<i>\$5,043.47</i>	<i>\$1,984.32</i>	<i>\$189.65</i>	<i>\$606.04</i>	<i>\$389.36</i>	<i>\$867.66</i>	<i>\$56,837.77</i>
<i>*Town of Mount Jackson</i>	<i>\$97,746.75</i>	<i>\$10,322.68</i>	<i>\$4,061.39</i>	<i>\$388.16</i>	<i>\$1,240.40</i>	<i>\$796.92</i>	<i>\$1,775.87</i>	<i>\$116,332.17</i>
<i>*Town of New Market</i>	<i>\$96,160.72</i>	<i>\$10,155.19</i>	<i>\$3,995.49</i>	<i>\$381.87</i>	<i>\$1,220.27</i>	<i>\$783.99</i>	<i>\$1,747.05</i>	<i>\$114,444.57</i>
<i>*Town of Woodstock</i>	<i>\$232,148.54</i>	<i>\$24,516.37</i>	<i>\$9,645.81</i>	<i>\$921.89</i>	<i>\$2,945.94</i>	<i>\$1,892.68</i>	<i>\$4,217.68</i>	<i>\$276,288.91</i>
<i>*Town of Strasburg</i>	<i>\$235,966.77</i>	<i>\$24,919.60</i>	<i>\$9,804.46</i>	<i>\$937.05</i>	<i>\$2,994.40</i>	<i>\$1,923.81</i>	<i>\$4,287.05</i>	<i>\$280,833.14</i>
<i>*Town of Toms Brook</i>	<i>\$14,979.22</i>	<i>\$1,581.90</i>	<i>\$622.39</i>	<i>\$59.48</i>	<i>\$190.08</i>	<i>\$122.12</i>	<i>\$272.14</i>	<i>\$17,827.35</i>
Warren County	\$1,725,997.00	\$157,189.00	\$31,232.00	\$990.00	\$22,414.00	\$4,358.00	\$7,123.00	\$1,949,303.00
<i>*Town of Front Royal</i>	<i>\$742,609.33</i>	<i>\$67,630.49</i>	<i>\$13,437.55</i>	<i>\$425.95</i>	<i>\$9,643.61</i>	<i>\$1,875.03</i>	<i>\$3,064.67</i>	<i>\$838,686.63</i>
City of Winchester	\$1,294,416.00	\$395,324.00	\$92,910.00	\$2,508.00	\$18,770.00	\$12,363.00	\$4,955.00	\$1,821,246.00
Total	\$10,001,965.00	\$1,204,398.00	\$374,939.00	\$40,649.00	\$129,632.00	\$45,555.00	\$72,529.00	\$11,869,667.00

All values are in thousands of dollars

**Denotes town values that are also included in totals for the respective county*

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Critical Facilities

Vulnerability to critical facilities from hurricane winds is fairly uniform throughout the region. As Appendix F shows, there is only slight variation from the northern to southern portions of the region. In general, critical facilities in the central and southern portions of the region (Shenandoah, Warren and Page Counties) may have a slightly higher vulnerability than those in the northern portion of the region (Frederick and Clarke Counties).

Loss Estimation

Table V-21 provides the loss estimations from HAZUS-MH by building type. As noted earlier, wood structures compose the majority of the structures, and also account for the majority of the losses. Table V-22 shows the loss by occupancy type. Note that the difference between the totals in the tables is due to rounding calculations in HAZUS-MH.

Table V-21. Building Stock Loss by Building Type (from HAZUS-MH)

Community	Concrete	Masonry	MH	Steel	Wood	Total
Clarke County	0.5563	18.5598	0.2378	2.4326	51.7713	73.5578
<i>*Town of Berryville</i>	0.1303	4.3466	0.0557	0.5697	12.1244	17.2267
<i>*Town of Boyce</i>	0.0187	0.6249	0.0080	0.0819	1.7432	2.4767
Frederick County	1.6970	55.9960	6.7683	8.6679	150.1503	223.2796
<i>*Town of Middletown</i>	0.0291	0.9599	0.1160	0.1486	2.5740	3.8276
<i>*Town of Stephens City</i>	0.0328	1.0838	0.1310	0.1678	2.9062	4.3216
Page County	0.5360	19.7173	3.2903	2.1368	52.1578	77.8382
<i>*Town of Luray</i>	0.1127	4.1439	0.6915	0.4491	10.9618	16.3589
<i>*Town of Stanley</i>	0.0307	1.1281	0.1882	0.1222	2.9840	4.4533
<i>*Town of Shenandoah</i>	0.0434	1.5977	0.2666	0.1731	4.2263	6.3071
Shenandoah County	1.7517	40.2255	2.3592	7.1200	101.4228	152.8791
<i>*Town of Edinburg</i>	0.0406	0.9324	0.0547	0.1650	2.3509	3.5436
<i>*Town of Mount Jackson</i>	0.0831	1.9083	0.1119	0.3378	4.8116	7.2528
<i>*Town of New Market</i>	0.0818	1.8774	0.1101	0.3323	4.7335	7.1351
<i>*Town of Woodstock</i>	0.1974	4.5323	0.2658	0.8022	11.4276	17.2253
<i>*Town of Strasburg</i>	0.2006	4.6069	0.2702	0.8154	11.6155	17.5086
<i>*Town of Toms Brook</i>	0.0127	0.2924	0.0172	0.0518	0.7374	1.1115
Warren County	1.3566	37.0882	1.4154	5.4890	98.1864	143.5356
<i>*Town of Front Royal</i>	0.5837	15.9572	0.6090	2.3616	42.2447	61.7561
City of Winchester	2.8628	41.5885	0.2452	14.1036	85.9966	144.7966
Total	8.7604	213.1753	14.3162	39.9499	539.6852	815.8869

All values are in thousands of dollars

**Denotes town values that are also included in totals for the respective county*

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Table V-22. Building Stock Loss By General Occupancy (from HAZUS-MH)

Community	Residential	Commercial	Industrial	Agri.	Religion	Gov't	Ed.	Total
Clarke County	68.4098	2.5230	1.5408	0.4961	0.3844	0.2315	0.0989	73.6844
<i>*Town of Berryville</i>	<i>16.0210</i>	<i>0.5909</i>	<i>0.3608</i>	<i>0.1162</i>	<i>0.0900</i>	<i>0.0542</i>	<i>0.0232</i>	<i>17.2563</i>
<i>*Town of Boyce</i>	<i>2.3034</i>	<i>0.0849</i>	<i>0.0519</i>	<i>0.0167</i>	<i>0.0129</i>	<i>0.0078</i>	<i>0.0033</i>	<i>2.4810</i>
Frederick County	206.0408	10.1155	5.2494	0.6565	0.9346	0.2284	0.5222	223.7474
<i>*Town of Middletown</i>	<i>3.5321</i>	<i>0.1734</i>	<i>0.0900</i>	<i>0.0113</i>	<i>0.0160</i>	<i>0.0039</i>	<i>0.0090</i>	<i>3.8356</i>
<i>*Town of Stephens City</i>	<i>3.9880</i>	<i>0.1958</i>	<i>0.1016</i>	<i>0.0127</i>	<i>0.0181</i>	<i>0.0044</i>	<i>0.0101</i>	<i>4.3307</i>
Page County	73.4566	2.7089	0.7590	0.3525	0.4884	0.1419	0.1333	78.0407
<i>*Town of Luray</i>	<i>15.4380</i>	<i>0.5693</i>	<i>0.1595</i>	<i>0.0741</i>	<i>0.1027</i>	<i>0.0298</i>	<i>0.0280</i>	<i>16.4014</i>
<i>*Town of Stanley</i>	<i>4.2026</i>	<i>0.1550</i>	<i>0.0434</i>	<i>0.0202</i>	<i>0.0279</i>	<i>0.0081</i>	<i>0.0076</i>	<i>4.4649</i>
<i>*Town of Shenandoah</i>	<i>5.9521</i>	<i>0.2195</i>	<i>0.0615</i>	<i>0.0286</i>	<i>0.0396</i>	<i>0.0115</i>	<i>0.0108</i>	<i>6.3235</i>
Shenandoah County	138.6507	7.9076	3.2545	0.3752	0.7335	1.0773	1.1049	153.1038
<i>*Town of Edinburg</i>	<i>3.2138</i>	<i>0.1833</i>	<i>0.0754</i>	<i>0.0087</i>	<i>0.0170</i>	<i>0.0250</i>	<i>0.0256</i>	<i>3.5488</i>
<i>*Town of Mount Jackson</i>	<i>6.5778</i>	<i>0.3751</i>	<i>0.1544</i>	<i>0.0178</i>	<i>0.0348</i>	<i>0.0511</i>	<i>0.0524</i>	<i>7.2634</i>
<i>*Town of New Market</i>	<i>6.4710</i>	<i>0.3691</i>	<i>0.1519</i>	<i>0.0175</i>	<i>0.0342</i>	<i>0.0503</i>	<i>0.0516</i>	<i>7.1456</i>
<i>*Town of Woodstock</i>	<i>15.6222</i>	<i>0.8910</i>	<i>0.3667</i>	<i>0.0423</i>	<i>0.0827</i>	<i>0.1214</i>	<i>0.1245</i>	<i>17.2506</i>
<i>*Town of Strasburg</i>	<i>15.8791</i>	<i>0.9056</i>	<i>0.3727</i>	<i>0.0430</i>	<i>0.0840</i>	<i>0.1234</i>	<i>0.1265</i>	<i>17.5344</i>
<i>*Town of Toms Brook</i>	<i>1.0080</i>	<i>0.0575</i>	<i>0.0237</i>	<i>0.0027</i>	<i>0.0053</i>	<i>0.0078</i>	<i>0.0080</i>	<i>1.1131</i>
Warren County	133.1438	7.9157	1.3192	0.0507	0.7237	0.4164	0.2282	143.7976
<i>*Town of Front Royal</i>	<i>57.2851</i>	<i>3.4057</i>	<i>0.5676</i>	<i>0.0218</i>	<i>0.3114</i>	<i>0.1791</i>	<i>0.0982</i>	<i>61.8689</i>
City of Winchester	117.4972	19.5422	5.7663	0.1697	0.7387	0.9043	0.2222	144.8407
Total	737.1989	50.7128	17.8893	2.1006	4.0034	2.9998	2.3097	817.2145
<i>All values are in thousands of dollars</i>								
<i>*Denotes town values that are also included in totals for the respective county</i>								

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Figure V-16 shows the total losses for each county. The hurricane wind mapping resolution, at the census tract level, does not support town-based analysis, since most towns would be represented by a portion of a census tract. In the future, as weather data has better spatial resolution, the ability to create practical town-based analysis will be improved.

The vulnerability analysis was designed to derive broad regional vulnerability comparisons, not pinpoint location comparisons. As the tables and maps illustrate, Frederick, Shenandoah, and Clarke Counties would expect to have higher losses than Page or Warren Counties. The southeast corner of Frederick County has a pocket with the highest annualized wind loss for the region (>\$40,000). The towns of Berryville, Boyce, Front Royal, and Woodstock have a medium annual wind loss (\$20,000-\$40,000) as compared to the towns of Stephens City, Middletown, Edinburg, Mount Jackson, New Market, Luray, Stanley, and Shenandoah that have a low annualized wind loss (<\$20,000).

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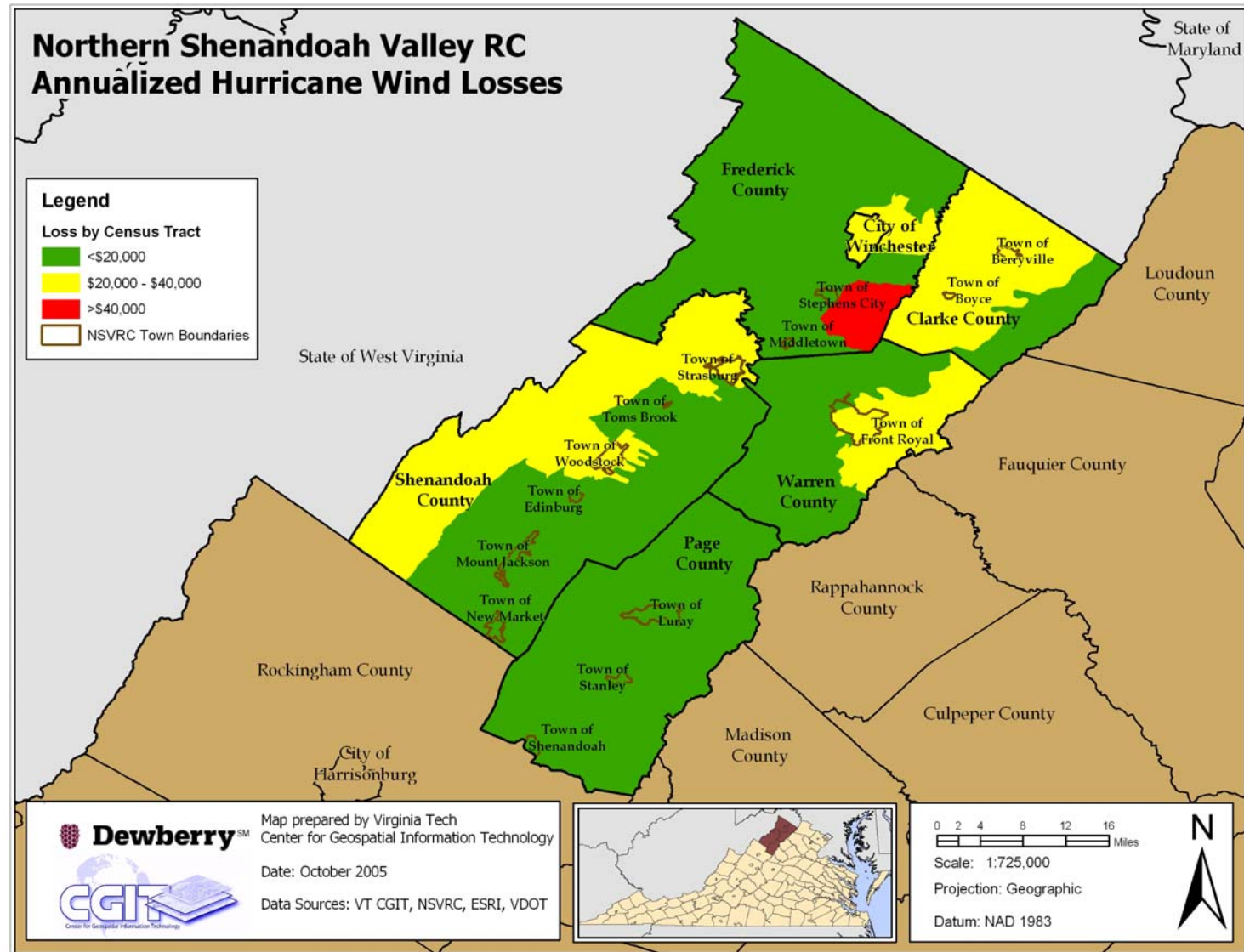


Figure V-16. Northern Shenandoah Annualized Total Hurricane Loss Estimate

Land Subsidence/ Karst (Limited Ranking)

Hazard Profile

Karst topography can be described as a landscape formed over limestone, dolomite, or gypsum, and is characterized by sinkholes, caves, and underground drainage. Much of the Northern Shenandoah Valley region exhibits karst topography, and the presence of sinkholes, sinking streams, springs, caves and solution valleys is common.

The collapse of land in the karst topography creates sinkholes. Sinkholes are classified as natural depressions of the land surface and are caused when the acidic groundwater dissolves the surrounding geology. Most of these events are triggered by human activity in the karst environment. Excessive pumping of groundwater from karst aquifers may rapidly lower the water table and cause a sudden loss of buoyant forces that stabilize the roofs of cavernous openings. Human-induced changes in surface water flow and infiltration also may cause collapse. Most sinkholes that form suddenly occur where soil that overlies bedrock collapses into the pre-existing void.

Sinkholes can cause damage to bridges, roads, railroads, storm drains, sanitary sewers, canals, levees, and private and public buildings. Another problem associated with karst topography is its impact on aquifers and potential for groundwater contamination. The greatest impact occurs when polluted surface waters enter karst aquifers. This problem is universal among all populated areas located in areas of karst. The groundwater problems associated with karst are accelerated with the advent of (1) expanding urbanization, (2) misuse and improper disposal of environmentally hazardous chemicals, (3) shortage of suitable repositories for toxic waste (both household and industrial), and (4) ineffective public education on waste disposal and the sensitivity of the karstic groundwater system.

Hazard Areas

Karst locations were digitized from the Virginia Department of Mines, Minerals, and Energy (DMME) [formerly the Department of Conservation and Economic Development Division of Mineral Resources]. A majority of the karst regions in Virginia follow Interstate 81, as seen in Figure V-17, running northeast to southwest through all of the jurisdictions in Northern Shenandoah. These areas are broadly defined and mapped with a general understanding of karst hazard risks. A more detailed study would be required to determine the actual vulnerable structures at individual sites within these risk areas.

Based on the experience and knowledge of local officials, karst was ranked as a “limited” hazard for the Northern Shenandoah Valley region relative to the other hazards considered in this plan. They based their ranking, in part, on the fact that extensive regulations and policies are already in place to address development in karst topography.

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In addition, the Northern Shenandoah Valley Regional Commission, with the assistance of Engineering Concepts Inc., has developed a planning guide (*Planning for Low Impact Development in the Northern Shenandoah Region of Virginia*) that can be used to develop a site suitability index for Low Impact Development (LID) practices in a karst region using GIS. This project was funded by a Chesapeake Bay Small Watershed Grant through the National Fish and Wildlife Foundation. As noted previously, the existing regulations and guidance prevent most development in the karst areas, therefore, karst poses a minimal hazard to life and property in the Northern Shenandoah Valley according to local officials.

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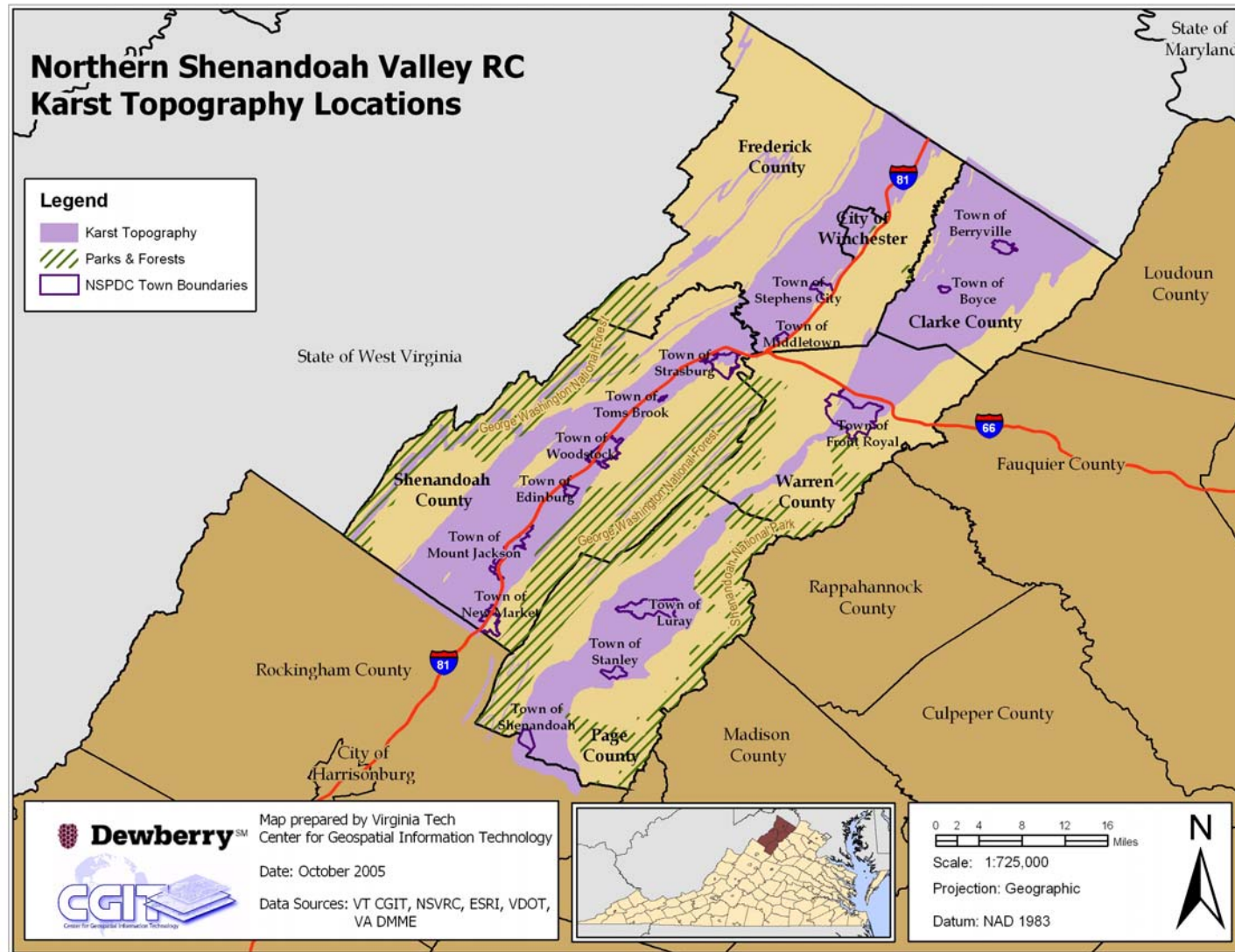


Figure V-17. Northern Shenandoah Karst Zones (VA DMME)

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Hazard History

Sinkholes caused by karst are site-specific and often occur in undeveloped areas. There is no existing long-term record for the Northern Shenandoah Valley region or for Virginia. However, in recent years there have been a number of sinkholes reported on Interstate 81.

Vulnerability Analysis

Table 23 illustrates the number of critical facilities in the mapped karst zones. Shenandoah (89%) and Warren (77%) counties and the City of Winchester (76%) have the largest percentage of total critical facilities in karst zones.

Table V-23. Northern Shenandoah Critical Facilities Near Mapped Karst Zones	
Community	Number of Critical Facilities
Clarke County	18
Frederick County	19
Page County	27
Shenandoah County	45
Warren County	43
City of Winchester	87
Total	239

Landslide/Steep Slopes (Limited Ranking)

Hazard Profile

A landslide is a downward movement of a slope and materials under the force of gravity. Landslide occurs when masses of rock, earth or debris move down a slope. Some move slowly causing gradual damage, while others move rapidly destroying property unexpectedly. They are activated by rainstorms, snowmelts, earthquakes, fires, volcanoes and by human modification to the land such as mining and construction. Common types of landslides include rock slides, slumps, mudslides, debris flows, avalanches, and earth flows. Types of landslides vary depending on the amount of water and type of materials that they carry. Landslides usually affect infrastructure such as roads and bridges, but they also can affect individual buildings and businesses, especially those located close to dangerous topographic features such as the top or base of slopes or in valleys. Landslides occur in every state and U.S. territory and are common throughout the Appalachian region, particularly where there are steep slopes, clay-rich soils, periodic heavy rains and vegetation loss caused by wildfires.

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Several natural and human factors may contribute to or influence landslides. How these factors interrelate is important in understanding the hazard. The three principal natural factors are topography, geology, and precipitation. The principle human activities are cut-and-fill construction for highways, construction of buildings and railroads, and mining operations. The Virginia Department of Mines, Minerals, and Energy (DMME) denoted that the most disastrous landslide events in Virginia are associated with heavy rainfall events along steep slopes of the Blue Ridge Mountains.

The USGS recognizes four major impacts caused by landslide:

- changes in elevation and slope of streams, canals, and drains
- damage to bridges, roads, railroads, storm drains, sanitary sewers, canals, and levees
- damage to private and public buildings
- failure of well casings from forces generated by compaction of fine-grained materials in aquifer systems

Landslides can cause serious damage to highways, buildings, homes, and other structures that support a wide range of economies and activities. Landslides commonly coincide with other natural disasters. For instance, hillsides and slopes denuded by wildfires may be more susceptible to landslides. Expansion of urban development contributes to greater risk of damage by landslides. Additionally areas with steep slopes, poor drainage, and erosion have a greater probability of landslides.

The USGS National Landslide Hazard Program has developed maps for landslide incidence and susceptibility in the conterminous United States. Figure V-18 is a regional zoom-in of this national map. It should be noted that the map layers were created at a 1:7,500,000 scale (1:2,500,000 scale for group formations) and are not intended for local planning or site selection. The map shows areas where large numbers of landslides have been recorded (incidence) and areas that may be susceptible to landslides because of their geologic composition (susceptibility).

According to the report that accompanies the incidence map, “susceptibility is not shown where it is comparable to incidence – for example, where areas of the highest category of incidence are assumed to have high susceptibility and where areas of the lowest category are assumed to have low susceptibility.”¹

The report goes on to state,

¹ Radbruch-Hall, Dorothy H. et al. United States Geologic Survey. *Landslide Overview Map of the Conterminous United States*. U.S. Geological Survey Professional Paper 1183. 1982.

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“The map was prepared by evaluating formations or groups of formations shown on the geologic map of the United States and classifying them as having high, medium, or low landslide incidence (number of landslides) and being of high, medium, or low susceptibility to landsliding. Those map units or parts of units with more than 15 percent of their area involved in landsliding were classified as having high incidence; those with 1.5 to 15 percent of their area involved in landsliding, as having medium incidence; and those with less than 1.5 percent of their area involved, as having low incidence. This classification scheme was modified where particular lithofacies are known to have variable landslide incidence or susceptibility.”

The susceptibility categories are largely subjective because insufficient data was available for precise determinations. Because the map is highly generalized, was created at a national scale, and is based on relatively old and imprecise data, it should not be taken as an absolute guide to landslide incidence and susceptibility and should not be used for site selection purposes.

Based on the experience and knowledge of local officials, landslides were ranked as a “limited” hazard for the Northern Shenandoah Valley region relative to the other hazards considered in this plan. They based their ranking on the limited number of incidents and the minimal impacts of past landslide occurrences.

Hazard History

The USGS data does not include incidence of any major landslides in the Northern Shenandoah Valley region.

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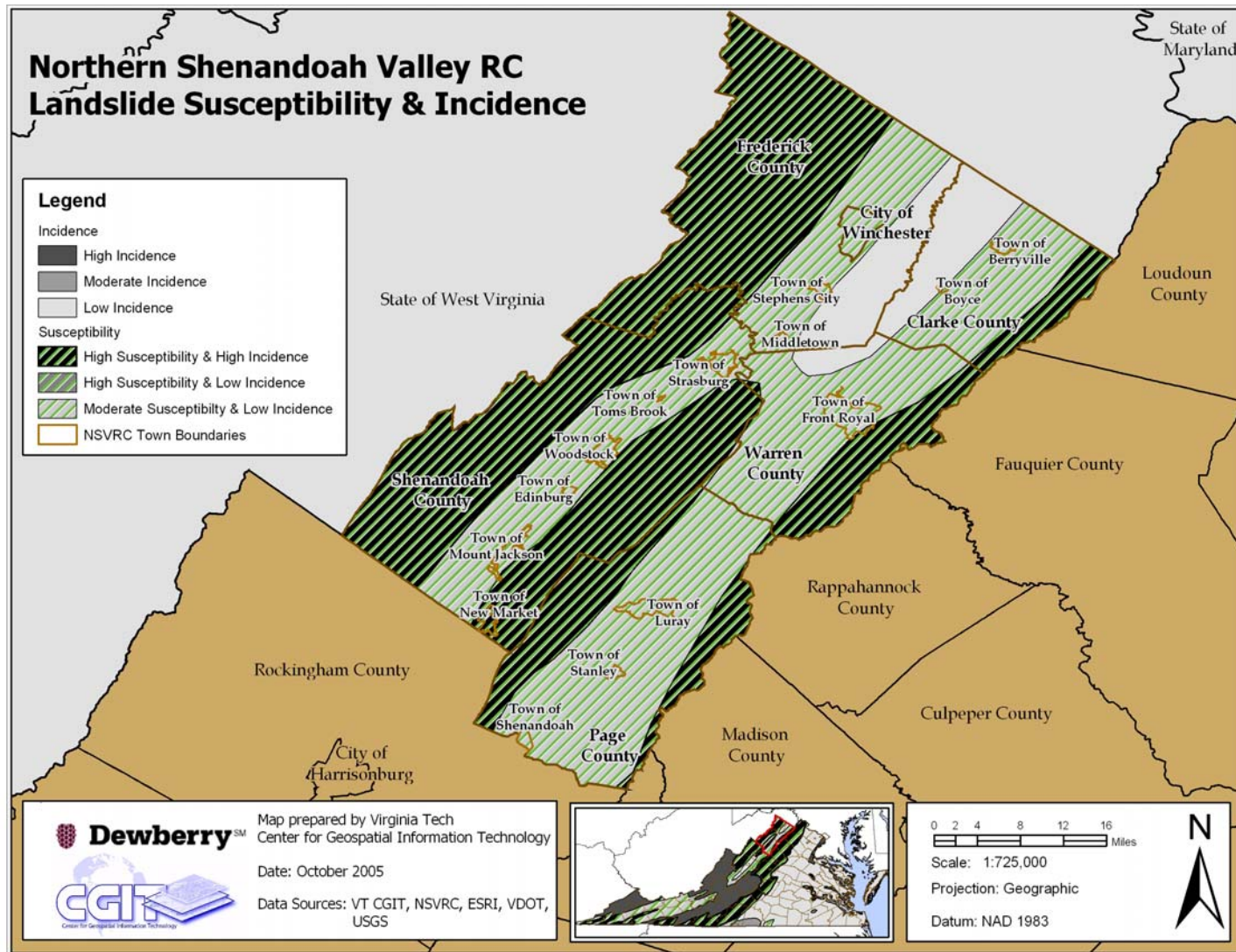


Figure V-18. Northern Shenandoah Landslide Susceptibility and Incidence (USGS)

Vulnerability Analysis

As Figure V-18 indicates, all of the localities have an increased vulnerability to landslides in the mountainous regions of Northern Shenandoah. Areas with high susceptibility and high incidence are centered on mountain ranges and national forests and parks. Figure V-18 illustrates these areas, specifically in the north where the George Washington National Forest and Shenandoah Mountains are located and to the southeast where Shenandoah National Park and the Appalachian Trail are located.

Tornado (Limited Ranking)

Hazard History

Appendix C includes descriptions of major tornado events that have touched down in the Northern Shenandoah. Events have been broken down by the date of occurrence and where available, by individual community descriptions. When no community specific description is available, the general description applies to the entire planning area.

Hazard Profile

Tornadoes are classified as a rotating column of wind that extends between a thunderstorm cloud and the earth's surface. Winds are typically less than 100 mph, with severe tornado wind speeds exceeding 250 mph. The rotating column of air often resembles a funnel shaped cloud. The widths of tornados are usually several yards across, with infrequent events being over a mile wide. Tornadoes and their resultant damage can be classified into six categories using the Fujita Scale. This scale assigns numerical values for wind speeds inside the tornado according to the type of damage and degree of the tornado. Most tornadoes are F0 and F1, resulting in little widespread damage. Tornado activity normally spans from April through July but tornados can occur at any time throughout the year. In Virginia, peak tornado activity is in July. Hot, humid conditions stimulate the tornadoes' growth.

Strong tornadoes may be produced by thunderstorms and often are associated with the passage of hurricanes. On average, about seven tornadoes are reported in Virginia each year. The total number may be higher as incidents may occur over areas with sparse populations, or may not cause any property damage.

Tornado damage is computed using the Fujita Scale, as shown in Table V-24. Classification is based on the amount of damage caused by the tornado, where the measure of magnitude is based on the impact.

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Table V-24. Fujita Tornado Intensity Scale

Classification	Max. Winds (mph)	Path Length (mi.)	Path Width (mi)	Damage
F0	less than 73	less than 1.0	less than 0.01	Chimneys damaged, trees broken
F1	73-112	1.0-3.1	0.01-0.03	Mobile homes moved off foundations or overturned
F2	113-157	3.2-9.9	0.03-0.09	Considerable damage, mobile homes demolished, trees uprooted
F3	158-206	31-Oct	0.10-0.29	Roof and walls torn down, trains overturned, cars thrown
F4	207-260	32-99	0.30-0.90	Well-constructed walls leveled
F5	261-318	100-315	1.0-3.1	Homes lifted off foundations and carried some distance, cars thrown as far as 300 ft

The classification of the tornado gives an approximate depiction of what the corresponding damage of the tornado will be. A majority of Virginia's tornadoes are F0 and F1 on the Fujita Scale, shown in Table V-25. These result in minimal extensive damage. Damage that is likely to occur would be damage to trees, shrubbery, signs, antennas, with some damage to roofs and unanchored trailers.

Table V-25. Virginia Tornado Statistics 1950-2001

Fujita Scale	Class.	MPH	Damage Description	# in VA	% of total	Deaths / Injuries	Damages (\$ Mil)
F0	Weak	40-72	Light damage. Tree branches snapped; antennas and signs damaged.	99	26	0 / 0	7
F1	Moderate	73-112	Moderate damage. Roofs off; trees snapped; trailers moved or overturned.	186	50	1 / 85	57
F2	Strong	113-157	Considerable damage. Weak structures and trailers demolished; cars blown off road.	66	18	3 / 72	75

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Table V-25. Virginia Tornado Statistics 1950-2001

Fujita Scale	Class.	MPH	Damage Description	# in VA	% of total	Deaths / Injuries	Damages (\$ Mil)
F3	Severe	158-206	Roofs and some walls torn off well constructed buildings; some rural buildings demolished; cars lifted and tumbled.	23	6	19 / 102	140
F4	Devastating	207-260	Houses leveled leaving piles of debris; cars thrown some distance.	2	0.1	4 / 248	50
F5	Incredible	261-318	Well built houses lifted off foundation and disintegrated with debris carried some distance.	0	0	n/a	n/a

Table V-26. Northern Shenandoah Tornado Statistics 1950-2004

County	F0	F1	F2	Total
Clarke County	4	3	1	8
Frederick County	2	3	2	7
Page County	0	1	0	1
Shenandoah County	1	1	1	3
Warren County	2	1	0	3
Total	9	9	4	22

Table V-26 and Figure V-19 show tornado occurrence in the Northern Shenandoah Valley region. Clarke and Frederick Counties have had the most tornado occurrences in the past 50 years in the region. Since major tornadoes are infrequent in the region, the Hurricane & High Wind analysis covers the impacts of more probable high wind occurrences. Appendix C includes the tornado descriptions for the individual events shown on Figure V-19.

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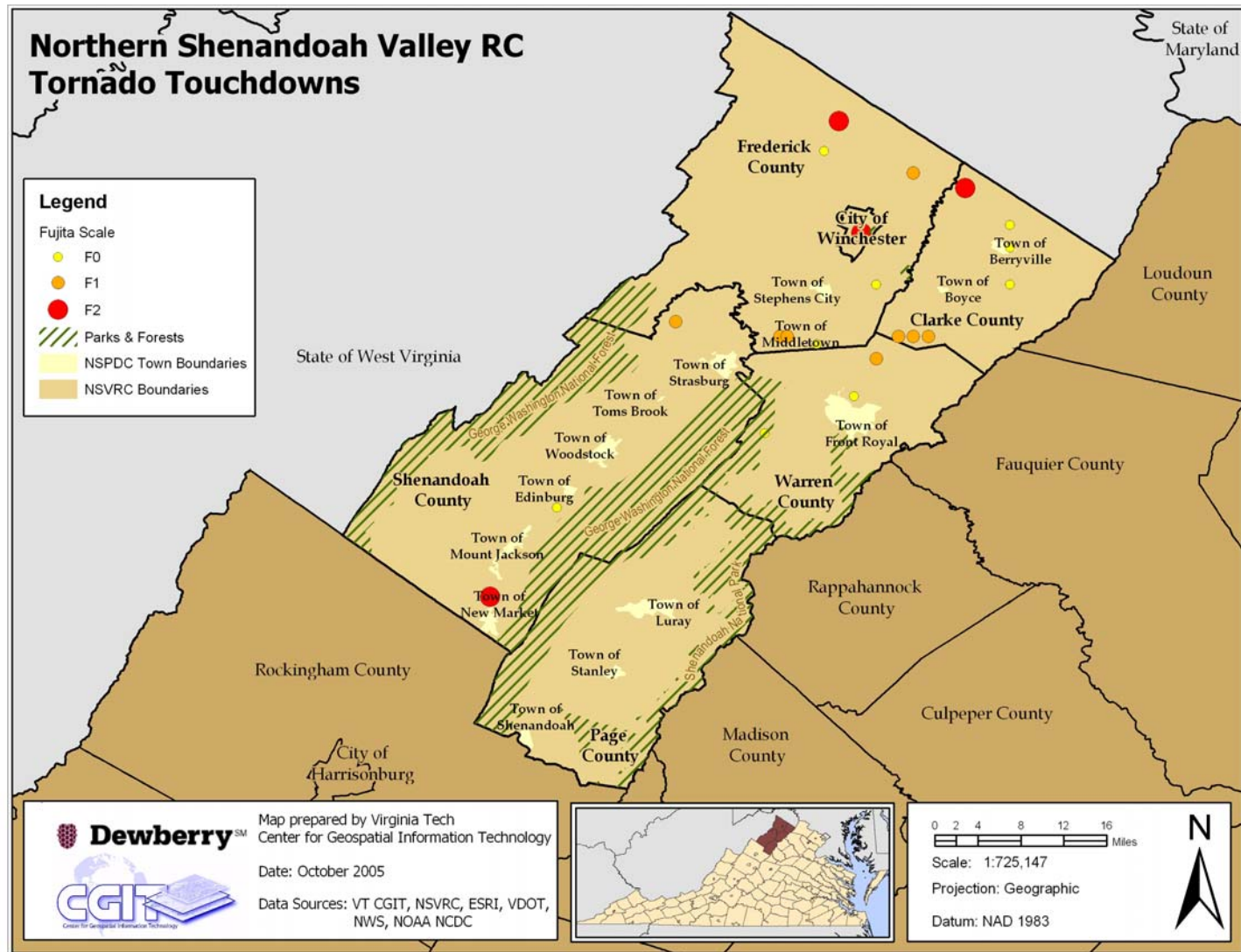


Figure V-19. Northern Shenandoah Tornado Touchdowns

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Human-Caused Hazard Events

The following sections address the impacts of human-caused hazards on the Northern Shenandoah Valley region. Human-caused hazards were included at the request of the communities in the planning district; these hazards are not required by VDEM or FEMA for the approval of the hazard mitigation plan.

The FEMA risk management series on mitigating potential terrorist attacks against buildings provides information on developing a realistic prioritization of human-caused hazards. The mitigation strategies section of this report should provide projects to address human-caused hazard vulnerability. Future analysis steps to consider include:

- Determine the relative importance of various critical and non-critical facilities
- Determine the vulnerability of each facility to a specified hazard
- Determine what human threats are known to exist in the communities

Each section provides a brief overview of the hazard, potential impacts and a general community vulnerability analysis. Ideally, analyses should be included and fully addressed in each community's emergency operations plan.

From the emergency operations plans provided (Tables V-27 and V-29), it appears that the communities in the planning area have already or are beginning to address these concerns. Due to the limited data available for the region and concerns about security and community data confidentiality, location-specific information is not included in the HIRA.

Hazardous Material Spills (Limited Ranking)

Hazard Profile

Hazardous materials can include explosive, flammable, combustible, corrosive, oxidizing, toxic, infectious, and radioactive materials that are involved in an accidental or intentional release causing danger to the general public. However, a spill still can be deemed hazardous if benign materials such as beverages or non-toxic materials cause a hazard to those in the immediate area. Hazardous material events also can be caused by natural hazards such as earthquakes and floods.

A hazard material spill or release may come from either fixed facilities or mobile containers. The duration of the event can last for hours or even days. Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. In addition, contamination may be carried out of the incident area by persons, vehicles, water, and wind.

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The magnitude of a hazardous material event is directly related to the amount of materials released, and the speed and efficiency of which emergency and clean up crews respond. Another important factor is what form the spill is in. Solid state spills are typically the easiest to clean up and control, followed by liquid and gaseous state spills. Liquid state spills require rapid response if they are to be contained, and if they infiltrate a watershed, steps must be taken to monitor the influence down stream. Gaseous state spills are almost impossible to contain, and depending on the volume, usually require evacuations down wind.

According to the United States Department of Transportation, highway incidents were responsible for 87% of the total United States hazardous material spills over the last 10 years. Damages from highway incidents alone accounted for \$365,677,814 over that period of time.

The United States Environmental Protection Agency tracks toxic chemical and other waste management activities for certain industries and federal facilities. Specific toxic release data is available for the Northern Shenandoah communities at <http://www.epa.gov/triexplorer/>. This information can provide an idea of what types of chemicals are present in the community.

Vulnerability Analysis

A detailed vulnerability analysis was not completed for hazardous materials spills in the planning area as a result of a lack of available data to fully assess the hazard. Appendix C lists the various types of spills, reported to the National Response Center (NRC), that have impacted the region from 1990 through 2005 for a total of 272 incidents. The table provides information on the location of the spill, date, type of incident, what was impacted, who was responsible for the incident and the type of chemicals involved. A majority of the spills have involved automotive gasoline, hydraulic and diesel oil. Table V-28 shows the type of incident by jurisdiction.

The jurisdictions in Northern Shenandoah address hazardous materials in their emergency operations plans (Table V-27). As a result of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title III), localities are required to develop detailed procedures to identify facilities with extremely hazardous materials and assure adequate emergency response capabilities. All of the counties and the City of Winchester have a detailed Hazardous Materials Incident Annex included in their emergency operations plans that takes into account hazardous material spills at fixed and mobile locations.

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Table V-27. Northern Shenandoah Community EOPs

Jurisdiction	Hazardous Material Response Addressed in EOP
Clarke County	Yes
<i>*Town of Berryville</i>	<i>Included in County EOP</i>
<i>*Town of Boyce</i>	<i>Included in County EOP</i>
Frederick County	Yes
<i>*Town of Middletown</i>	<i>Included in County EOP</i>
<i>*Town of Stephens City</i>	<i>Included in County EOP</i>
Page County	Yes
<i>*Town of Luray</i>	<i>Included in County EOP</i>
<i>*Town of Stanley</i>	<i>Included in County EOP</i>
<i>*Town of Shenandoah</i>	<i>Included in County EOP</i>
Shenandoah County	Yes
<i>*Town of Edinburg</i>	<i>Included in County EOP</i>
<i>*Town of Mount Jackson</i>	<i>Included in County EOP</i>
<i>*Town of New Market</i>	<i>Included in County EOP</i>
<i>*Town of Woodstock</i>	<i>Included in County EOP</i>
<i>*Town of Strasburg</i>	<i>Included in County EOP</i>
<i>*Town of Toms Brook</i>	<i>Included in County EOP</i>
Warren County	Yes
<i>*Town of Front Royal</i>	<i>Included in County EOP</i>
City of Winchester	Yes

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Table V-28. Hazardous Materials Spills by Jurisdiction and Type of Spill (1990-2005) (NRC)

Jurisdiction	Aircraft	Fixed	Mobile	Pipeline	R/R	R/R non-release	Storage tank	Unknown sheen	Vessel	Total
Clarke County	0	4	0	0	0	0	2	0	1	7
<i>*Town of Berryville</i>	0	5	0	0	0	0	0	0	0	5
<i>*Town of Boyce</i>	0	0	0	0	0	0	0	0	0	0
Frederick County	0	1	1	1	0	0	0	0	3	6
<i>*Town of Middletown</i>	0	1	0	0	0	0	0	0	0	1
<i>*Town of Stephens City</i>	0	5	1	0	0	0	0	1	0	7
Page County	0	1	0	1	0	0	0	0	1	3
<i>*Town of Luray</i>	0	4	2	2	0	0	0	0	0	8
<i>*Town of Stanley</i>	0	4	1	0	1	0	0	0	0	6
<i>*Town of Shenandoah</i>	0	2	1	0	11	0	0	0	0	14
Shenandoah County	0	5	0	1	1	0	0	0	0	7
<i>*Town of Edinburg</i>	0	0	0	0	0	0	0	0	0	0
<i>*Town of Mount Jackson</i>	1	1	4	0	0	1	1	1	0	9
<i>*Town of New Market</i>	0	2	0	0	0	0	0	0	0	2
<i>*Town of Woodstock</i>	0	2	0	0	0	0	0	0	0	2
<i>*Town of Strasburg</i>	0	6	2	0	0	1	0	0	0	9
<i>*Town of Toms Brook</i>	0	0	1	0	0	0	2	0	0	3
Warren County	0	1	3	0	3	1	1	0	0	9
<i>*Town of Front Royal</i>	0	12	2	1	4	0	1	2	0	22
City of Winchester	0	26	12	0	0	0	3	2	0	43
Total	1	82	30	6	20	3	10	6	5	163

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FEMA has established general methods for assessing human-caused hazards for buildings but does not have an established methodology for addressing community vulnerability due to hazardous materials spills. As with any analysis, general methods to determine vulnerability would be to identify where the hazard could occur and what the impacts on specific assets would be. For hazardous materials spills, general methods to determine vulnerability would be to determine what facilities use or produce hazardous materials and which high traffic roads and railroads are used to transport organic and inorganic materials in and out of the communities. After the potential contaminants have been identified, the extent, impact and effects of the contaminant can be determined.

Individuals can obtain information on facilities that may affect their home, workplace or other specific locations from the U.S. Environmental Protection Agency by visiting <http://yosemite.epa.gov/oswer/ceppoweb.nsf/frmVZIS?OpenForm>.

A strategy to improve available data should be considered for inclusion in the Mitigation Strategy section of this plan.

Pipelines (Limited Ranking)

Hazard Profile

Pipelines are used primarily to transport natural gas and petroleum, although pipelines may carry other hazardous materials. The material in pipelines can be emitted very quickly and in large quantities if the pipeline is ruptured. In these situations, the materials may continue to accumulate until the flow is turned off by a valve or at a nearby pumping station. A human-caused pipeline failure can come from improvised explosive devices or arson/incendiary attack. Explosive devices can originate from an individual person, a vehicle, or a projectile. The explosion is typically instantaneous, with secondary fall-out from spilled hazardous material in the immediate areas (see hazardous material spills for potential impacts) and loss of service to those dependent on the pipeline infrastructure.

Natural gas production in Virginia occurs in the southwestern portion of the state (Figure V-20), and accounts for about one-third of 1 percent of the United States gas consumption in 2000. Petroleum production also takes place in southwestern Virginia (Figure V-21), in Lee and Wise Counties.

The majority of Virginia's natural gas is supplied from a network of interstate pipelines that connect the nation's major gas producing areas, including Louisiana, Texas, and the Gulf of Mexico, to northeastern population centers such as New York, Boston, and Washington, DC. Because Virginia is located along these pipeline routes, large quantities of gas move through the state. Ships and barges, railroads, pipelines, and trucks are all essential components of the

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petroleum-product transportation network. Figure V-20 shows the general location of natural gas pipelines in Virginia.

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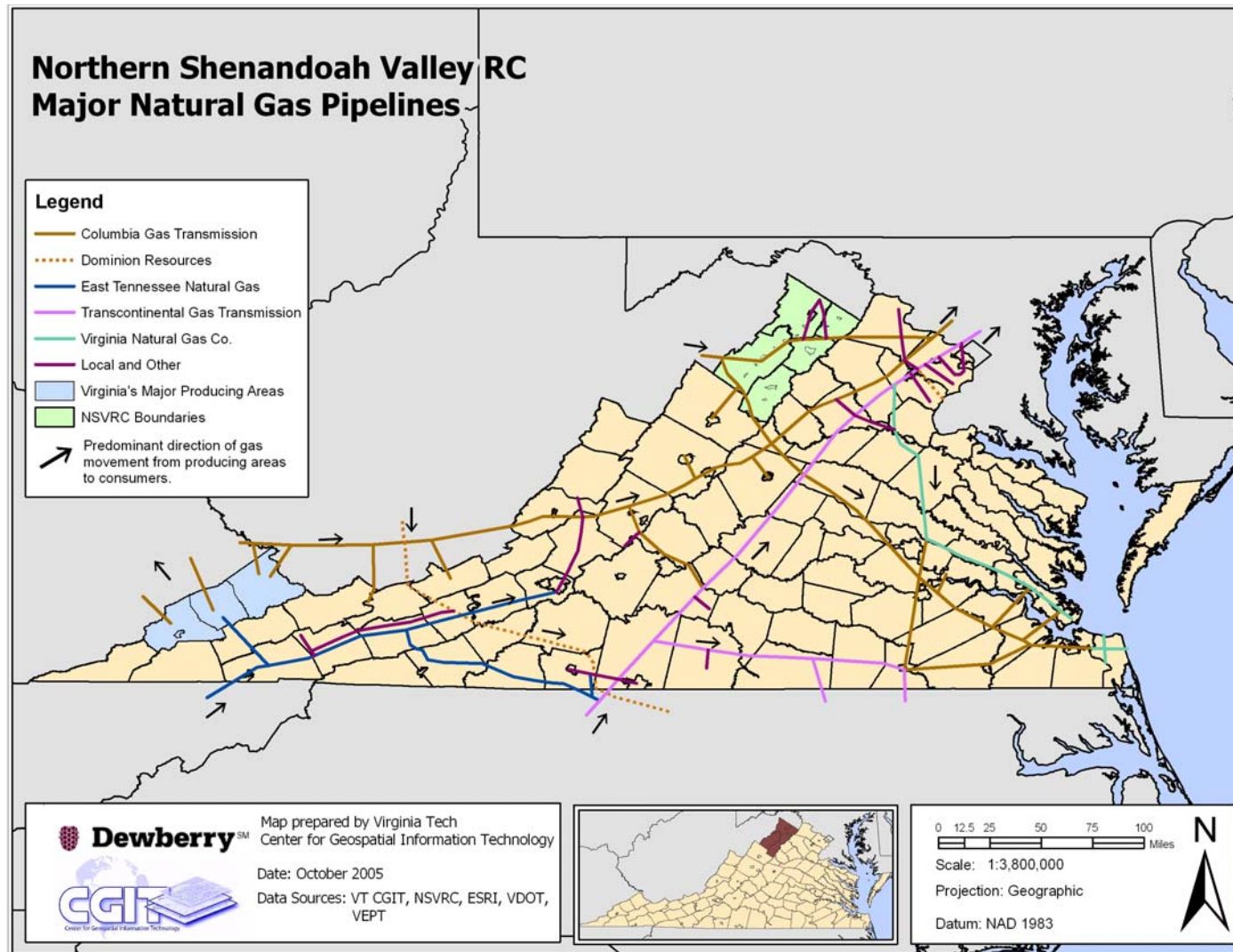


Figure V-20. Major Natural Gas Pipelines in Virginia.

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A petroleum-product pipeline network serves Virginia and the rest of the nation. Pipelines are the primary means for transporting refined petroleum products over long distances. Petroleum products are shipped through these pipelines to product terminals located throughout the state. Trucks are a common means of transporting products from these terminals to individual distribution points, such as gasoline service stations and fuel oil distributors. Figure V-21 shows the general location of petroleum pipelines in Virginia.

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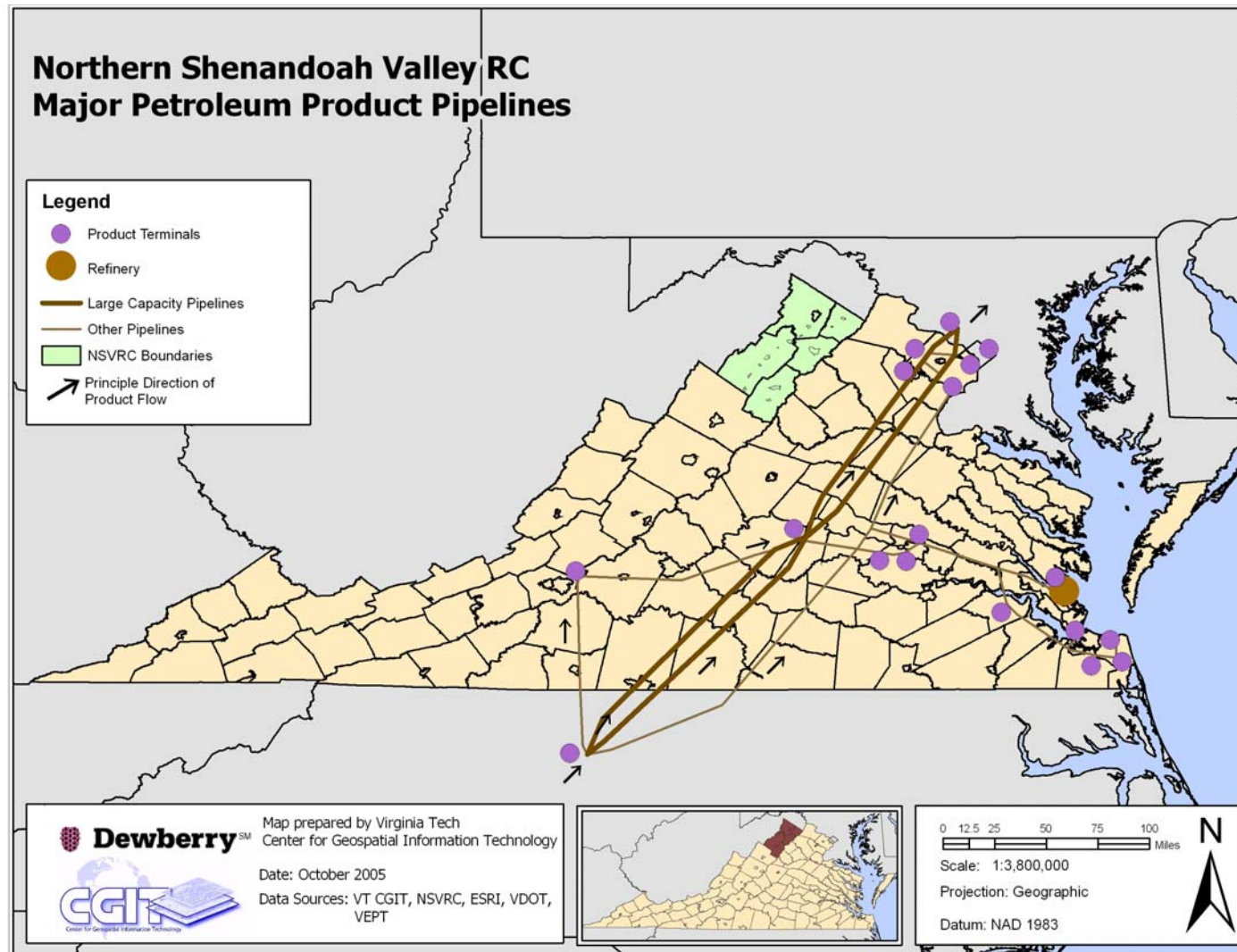


Figure V-21. Major Petroleum Product Pipelines in Virginia.

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The two main causes of pipeline rupture are puncture and corrosion. Pipelines that run through populated areas use pipes with a greater wall thickness to provide a high level of protection. To block corrosion, the pipe is coated with special materials. The welds that join pieces of pipe into a single long line are wrapped with a special protective material before the pipeline is placed in the ground. Since ordinary water and hydrocarbons can cause rapid corrosion, those materials are removed from the natural gas at processing plants where appropriate. Pipelines also are made more resistant to corrosion by cathodic protection. A small electrical current is run around buried pipe in the system to hold down the corrosive effects of the soil. This type of protection is required by the U.S. Department of Transportation.

If a pipeline ruptures, fires may ignite and should not be put out until official personnel shut off pipeline flow from the nearest pump station. Ruptures can cause large spills or toxic plumes that may have adverse effects on the surrounding environment. The magnitude is quantified by the geographic extent, type of material, and concentration of the plume or spill.

Vulnerability Analysis

Information on the exact location of pipelines is restricted to local, state and federal officials and pipeline operators. Natural gas lines from Columbia Gas Transmission as well as local gas lines are located throughout the Northern Shenandoah Valley region, as shown on Figure V-20. As shown in Figure V-21, no major petroleum product pipelines, product terminals or refineries are located in Northern Shenandoah. Information on how local officials can access detailed information can be found on the US Department of Transportation's *National Pipeline Mapping System* website at: http://www.npms.rspa.dot.gov/data/data_template.htm.

FEMA has not established a methodology for addressing the vulnerability of pipelines at a community level. As with any analysis, general methods to determine vulnerability would be to identify where the hazard would occur and what the impacts on specific assets would be. General methods to determine vulnerability to pipelines would be to determine where the major pipelines run through the communities and what they are carrying. After identifying where the pipelines are present, the areas served and the extent and impact of the expected rupture should be identified.

A strategy to improve available data should be considered for inclusion in the Mitigation Strategy section of this plan.

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Mass Evacuation from Northern Virginia (Limited Ranking)

Hazard Profile

Mass evacuations from urban areas can strain a community's resources and cause gridlock on major transportation routes, overcrowding of hospitals and shelters, and increased load on local utility infrastructures leading to potential failure.

The Virginia Department of Transportation (VDOT) has worked with the localities in and surrounding Northern Virginia to develop incident plans that include evacuation routes. When an event occurs, the Emergency Alert System (EAS) provides the latest information on evacuation. The Northern Shenandoah Valley planning area is divided into two EAS areas (Shenandoah Valley and Winchester).

Northern Shenandoah Valley community emergency operations plans outline the concerns surrounding mass evacuation, in terms of jurisdictional evacuation, evacuation of other areas in which the locality acts as a "host," or as a transit route locale.

Vulnerability Analysis

A major concern for the Northern Shenandoah Valley region is the possibility of a mass evacuation of the Northern Virginia/Washington D.C metro area due to a potential or actual terrorist attack. Researchers at the Institute for Infrastructure and Information Assurance (IIIA), which is part of James Madison University (JMU), have conducted preliminary studies to determine the possible number of displaced residents that may need to be temporarily housed in the region, and the impact resulting from the increased traffic flow on Interstates 64, 66, and 81. JMU IIIA has developed a Rural Citizen's Guide for Emergency Preparedness that provides citizens with information on threats facing rural areas and ways to prepare for emergencies (natural and man-made). Terrorism-related issues for Northern Virginia and adjacent regions will require extensive intra-regional planning and cooperation in the future.

The City of Winchester and the counties of the Northern Shenandoah Valley region address evacuation in their emergency operations plans (Table V-29). Some of the localities have detailed evacuation routes in the Warning, Evacuation, and Emergency Transportation Annex of their emergency operations plans. The jurisdictions have established traffic control measures and routes to enhance the rate of evacuation and to provide security for evacuated areas, critical facilities, and resources. The emergency operations plans address evacuation from the locality, and touch on the potential impacts caused by a mass evacuation from the Northern Virginia area. The type and scale of event that warrants evacuation from Northern Virginia will drive the type of response the localities will implement. To assist and mitigate against mass evacuation from Northern Virginia, jurisdictions should include additional

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detail in their plans regarding secondary evacuation routes, the number and location of potential shelters, and what needs the communities foresee as a “host” community.

Table V-29. Northern Shenandoah Mass Evacuation	
Jurisdiction	Mass Evacuation Addressed in EOPs
Clarke County	Yes
<i>*Town of Berryville</i>	<i>Included in County EOP</i>
<i>*Town of Boyce</i>	<i>Included in County EOP</i>
Frederick County	Yes
<i>*Town of Middletown</i>	<i>Included in County EOP</i>
<i>*Town of Stephens City</i>	<i>Included in County EOP</i>
Page County	Yes
<i>*Town of Luray</i>	<i>Included in County EOP</i>
<i>*Town of Stanley</i>	<i>Included in County EOP</i>
<i>*Town of Shenandoah</i>	<i>Included in County EOP</i>
Shenandoah County	Yes
<i>*Town of Edinburg</i>	<i>Included in County EOP</i>
<i>*Town of Mount Jackson</i>	<i>Included in County EOP</i>
<i>*Town of New Market</i>	<i>Included in County EOP</i>
<i>*Town of Woodstock</i>	<i>Included in County EOP</i>
<i>*Town of Strasburg</i>	<i>Included in County EOP</i>
<i>*Town of Toms Brook</i>	<i>Included in County EOP</i>
Warren County	Yes
<i>*Town of Front Royal</i>	<i>Included in County EOP</i>
City of Winchester	Yes

Section VI. Capability Assessment

Introduction

This portion of the Plan assesses the current capacity of the communities of the Northern Shenandoah Valley to mitigate the effects of the natural hazards identified in Section V of the plan. This assessment includes a comprehensive examination of the following local government capabilities:

- ❖ *Administrative and Technical Capability*
- ❖ *Fiscal Capability*
- ❖ *Policy and Program Capability*
- ❖ *Legal Authority*

The purpose of conducting the capability assessment is to identify potential hazard mitigation opportunities available to the Northern Shenandoah's local governments, specifically Clarke, Frederick, Page, Shenandoah, and Warren Counties and the City of Winchester. Careful analysis should detect any existing gaps, shortfalls, or weaknesses within existing governmental activities that could exacerbate a community's vulnerability. The assessment also will highlight the positive measures already in place or being completed at the local level which should continue to be supported and enhanced, if possible, through future mitigation efforts.

The capability assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for the Planning District to pursue under this plan, but assures that those goals and objectives are realistically achievable under given local conditions.

Administrative and Technical Capability

As described previously, the planning area is comprised of five counties and one city. The counties operate under a Board of Supervisors – County Administrator/Manager system. In this form of government, the elected board of supervisors hires a county administrator or manager who oversees daily operations of the county. Warren and Clarke Counties have the smallest Board of Supervisors with five members. Shenandoah and Page Counties have six board members while Frederick County has seven members.

The Town of Edinburg has a Mayor who also serves as town manager and a six person Town Council who are the only elected officials of the Town.

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The Town of Front Royal has a Mayor and a six person Town Council who are the only elected officials of the Town. A Town Manager is appointed by the Town Council and as the Chief Administrative Officer the Town Manager is responsible for carrying out the policies of the Council and for the management of all municipal activities.

The Town of Luray has a Mayor and a six person Town Council who are the only elected officials of the Town. A Town Manager is appointed by the Town Council and is responsible for carrying out the policies of the Council.

The Town of Mount Jackson has seven member Town Council, which includes a Mayor and Vice Mayor. There is a Town Manager who is responsible for carrying out the policies of the Council.

The Town of New Market has seven member Town Council, which includes a Mayor and Vice Mayor. There is a Town Manager who is responsible for carrying out the policies of the Council.

The Town of Shenandoah has a Mayor, a Vice Mayor, and a five person Town Council who are the only elected officials of the Town. There is a Town Manager who is responsible for carrying out the policies of the Council.

The Town of Stanley has a Mayor and a Town Council. There is a Town Manager who is responsible for carrying out the policies of the Council.

The Town of Stephens City has a Mayor and a Town Council. There is also a Town Administrator who carries out the policies of the Council and manages the Town.

The City of Winchester operates under the City Council – City Manager system. The City Council is elected and has thirteen members. They, in turn, appoint a City Manager who acts as the chief administrative officer and oversees daily business operations of the city.

Mitigation cuts across many disciplines. For a successful mitigation program, it is necessary to involve a broad range of people with diverse backgrounds. These people include planners, engineers, building inspectors, emergency managers, floodplain managers, people familiar with Geographic Information Systems (GIS), and grant writers.

GIS systems can best be described as a set of tools (hardware, software and people) used to collect, manage, analyze and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations. GIS is invaluable in identifying areas vulnerable to hazards. Frederick County, Shenandoah County, Warren County and the City of Winchester also provide access to on-line GIS mapping.

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Table VI-1 summarizes the technical capabilities of the jurisdictions. Where available, the specific department that has the technical capability is identified. For the most part, it was determined that the departments are adequately staffed, trained, and funded to accomplish their missions.

All of the counties and the city have government websites that could be utilized to promote hazard mitigation. Stream and rain gauges located within Shenandoah, Page and Warren Counties are part of the state Automated Flood Warning System (AFWS) and the National Weather Service's Integrated Flood Observation and Warning System (IFLOWS).

Table VI-1. Technical Capability Matrix

Jurisdiction	Planners		Number	Hazards Planners		Number	Emergency Manager		Number	Floodplain Manager		Number
	Yes	No		Yes	No		Yes	No		Yes	No	
Clarke Co.	✓		2		X		X		1 (Part-time)		X	
Frederick Co.	✓		8		X	0	✓		1		X	0
Town of Stephens City	✓		1		X	0		X	0		X	0
Page Co.	✓		1		X	0	✓		1	✓		1
Town of Luray	✓		1		X	0	✓		1		X	0
Town of Shenandoah*	✓		1									
Town of Stanley		X	0		X	0	✓		1		X	0
Shenandoah Co.	✓		2	✓		1	✓		2		X	0
Town of Edinburg**	✓		1									
Town of Mount Jackson	✓		.5									
Town of New Market	✓		1									
Warren Co.	✓				X		✓		1	✓		0
Town of Front Royal	✓		2		X	0		X	0		X	0
City of Winchester	✓			✓			✓				X	

*The Town Manager and Assistant Town Manager for the Town of Shenandoah spend approximately 40% of their time doing tasks that would fall into the categories of General Planning, Hazard Planning, Emergency Planning, Floodplain Management, and Zoning. Therefore, although the Town of Shenandoah does not have a planning department, one full time person is being counted in the Planners column for the Town of Shenandoah. The Mayor/Town Manager of Edinburg, as part of his duties, carries out duties related to General Planning, Hazard Planning, Emergency Planning, Floodplain Management, and Zoning.

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Table VI-1. Technical Capability Matrix (cont.)

Jurisdiction	GIS		Number	Fire Marshall		Number	Zoning Staff		Number	Building Inspectors		Number
	Yes	No		Yes	No		Yes	No		Yes	No	
Clarke Co.	✓		2		X		✓		2	✓		2
Frederick Co.	✓		5	✓		4	✓		1	✓		10
Town of Stephens City		X	0		X	0	✓		2	✓		
Page Co.	✓		1		X	0	✓		2	✓		1.5
Town of Luray		X	0		X	0	✓		1		X	0
Town of Shenandoah												
Town of Stanley		X	0		X	0	✓		1		X	0
Shenandoah Co.	✓		1	✓		1	✓		1	✓		6
Town of Edinburg			County		County							County
Town of Mount Jackson							✓		.5			
Town of New Market												
Warren Co.	✓				X		✓			✓		
Town of Front Royal	✓		1		X	0	✓		2		X	0
City of Winchester	✓			✓			✓			✓		

Fiscal Capability

For Fiscal Year 2005, the budgets of the participating jurisdictions range from \$1.02 million (Town of Stephens City) to \$181 million (Frederick County). Table VI-2 shows the total budget amounts for each jurisdiction in addition to the amount budgeted for public safety.

The counties and cities receive most of their revenue through state and local sales tax, local services, and through restricted intergovernmental contributions (federal and state pass through dollars). It is unlikely that any of the counties or cities could easily afford to provide the local match for the existing hazard mitigation grant programs. Considering the current budget situation at both the state and local government level in Virginia, combined with the apparent increased reliance on local accountability by the federal government, this is a significant and growing concern.

Under the Disaster Mitigation Act of 2000, FEMA has made special accommodations for "small and impoverished communities," who will be eligible for a 90% federal share, 10%

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non-Federal cost share for projects funded through the Pre-Disaster Mitigation (PDM) grant program. The definition is restricted to “communities of 3,000 or fewer individuals that is identified by the State as a rural community.” According to the current Interim Final Rule for Section 322 of the Act, none of the primary jurisdictions (counties and cities) in the planning area qualify as a small and impoverished community.

Table VI-2. FY05 Budget Information by Jurisdiction				
Jurisdiction	Overall	Public Safety	Planning	Hazard Mitigation
Clarke County*	\$29,752,774	2,347,289	585,566	\$0
Frederick County**	\$180,532,087	\$15,362,320	\$905,869	\$0
Town of Stephens City	\$1,020,300	\$191,300	\$31,700	\$0
Page County	No information provided	No information provided	No information provided	No information provided
Town of Luray**	\$9,353,000	\$918,000	\$191,000	\$10,000
Town of Shenandoah**	\$2,857,261	\$184,409	\$1,800	\$0
Town of Stanley**	\$1,422,330	\$199,727	\$0	\$0
Shenandoah County	\$78,500,000	\$2,487,276***	\$300,543#	No information provided
Town of Edinburg	\$1,238,184	\$128,551	\$0	\$0
Town of Mount Jackson	\$1,400,000	\$275,000	Unknown	\$0
Town of New Market	Approx. \$3,000,000	Approx. \$325,000	\$0	\$0
Warren County	No information provided	No information provided	No information provided	No information provided
Town of Front Royal##	\$27,445,708	\$2,903,309	\$476,490	\$0
City of Winchester	\$83,028,771	\$12,309,054	\$701,700	Included in public safety
* Actual expenditures scheduled 2 FY05 CAFR ** Reflects FY05 original budget appropriations ***Excludes law enforcement # Includes annual contribution to Regional Commission ## Reflects FY07 original budget appropriations				

As can be seen in Table VI-3, the jurisdictions in the planning area are accustomed to using a variety of financial tools. The ability to use these tools for hazard mitigation, however, differs from jurisdiction to jurisdiction.

As the table shows, virtually every jurisdiction uses a capital improvements program to plan for major expenditures and capital investments. Also, five of the ten jurisdictions have or are using Community Development Block Grant funds. Frederick County, Shenandoah County, Warren County, the City of Winchester, the Town of Front Royal, and the Town of Shenandoah use a special purpose tax or tax district.

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Table VI-3. Financial Mechanisms Available By Jurisdiction

Type of Funding Mechanism	Clarke County	Frederick County	Town of Stephens City	Page County	Town of Luray	Town of Shenandoah	Town of Stanley
<i>Development Impact Fees</i>			✓		Planning		✓
<i>Capital Improvement Programming</i>	✓	✓	✓	✓	Town Manager	Planning Department	✓
<i>Community Development Block Grant</i>	✓		✓	Dept. of Environmental Services	Town Manager; Virginia Main Street Group		
<i>General obligation, revenue, or special tax bonds</i>	✓	✓	✓		Revenue Bonds	Finance Department	✓
<i>Special purpose taxes or taxing district</i>		✓	✓			Tax Department	
<i>Gas/electric utility fees</i>						Tax Department	
<i>Water/sewer fees</i>	✓		✓		✓	Office Staff	✓
<i>Stormwater utility fees</i>							
<i>Partnering arrangements or intergovernmental agreements</i>	✓	Fire and Rescue; County Administrator	✓	County Administration		Page County Building Insp.	✓
<i>Other</i>							

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Table VI-3. Financial Mechanisms Available By Jurisdiction

Type of Funding Mechanism	Shenandoah County	Town of Edinburg	Town of Mount Jackson	Town of New Market	Warren County	Town of Front Royal	City of Winchester
<i>Development Impact Fees</i>			Town Manager/Zoning Administrator			✓	Planning
<i>Capital Improvement Programming</i>	County Administration	Town Manager, Town Treasurer	Town Treasurer/Town Manager	Town Manager's Office	✓	Town Manager	Planning/Finance
<i>Community Development Block Grant</i>	✓		Administrative Assistant	Town Manager's Office			Planning/Development
<i>General obligation, revenue, or special tax bonds</i>	✓	Town Manager, Town Treasurer		Town Manager's Office	✓	Town Manager	Finance/Treasurer/ City Manager
<i>Special purpose taxes or taxing district</i>	✓				✓	✓	Treasure/Finance
<i>Gas/electric utility fees</i>	✓			Treasurer's Office		Town Manager	Treasure/Finance
<i>Water/sewer fees</i>	✓	Town Manager, Town Treasurer	Town Manager/Town Treasurer	Treasurer's Office		Town Manager	Environmental Manager
<i>Stormwater utility fees</i>							
<i>Partnering arrangements or intergovernmental agreements</i>	Fire and Rescue	Town Manager, Town Treasurer	Town Manager	Town Manager's Office		Town Manager	City Manager
<i>Other</i>	Sanitary Districts		Town Manager		Sanitary Districts		City Manager

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Policy and Program Capability

Previous Mitigation Efforts

Shenandoah County acquired ten properties and elevated five other properties through the FEMA Flood Hazard Mitigation Program following the two devastating floods in 1996. The demolished properties were located in the Deer Rapids, Columbia Furnace, and Leisure Point areas.

Emergency Operations Plan

A Comprehensive Emergency Management Plan typically predetermines actions to be taken by government agencies and private organizations in response to an emergency or disaster event. For the most part, the plan describes the jurisdiction's capabilities to respond to emergencies, and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster. In addition, the plans in the Northern Shenandoah Valley address hazardous materials and mass evacuation from Northern Virginia.

Hazard mitigation generally is addressed through an annex to the plan. The annex lays out roles and responsibilities related to hazard mitigation for various agencies and departments. There are no foreseeable conflicts between those emergency operations plans and this hazard mitigation plan. Jurisdictions are encouraged to incorporate information from this plan into their emergency operations plans as appropriate.

Floodplain Management

Communities that regulate development in floodplains are able to participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally-backed flood insurance policies available for eligible properties in the community. Table VI-4 shows when each of the jurisdictions began participating in NFIP. The table also provides the date of the Flood Insurance Rate Map (FIRM) in effect in each community. These maps were developed by FEMA or its predecessor, and show the boundaries of the 100-year and 500-year floods. As the table shows, eight of the maps are over twenty years old and two of the maps are over fifteen years old. Seven communities have received updated maps within the past four years. Parts of the planning area have experienced growth over the past decade that may not be reflected in the FIRM. This difference may mean that the actual floodplain varies from that depicted on the map.

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Table VI-4. NFIP Entry and FIRM Date

<i>Jurisdiction</i>	<i>Entry into NFIP</i>	<i>Date of Current FIRM</i>	<i>Stand alone or part of zoning ordinance?</i>
<i>Clarke County</i>	1/17/75	9/24/84	Zoning
<i>Town of Berryville</i>	04/08/77	05/02/02	
<i>Frederick County</i>	11/8/74	7/17/78	Zoning
<i>Town of Middletown</i>	6/10/77	8/3/84	
<i>Town of Stephens City</i>	6/28/74	9/10/84	Stand alone
<i>Page County</i>	11/22/74	8/19/91	Zoning
<i>Town of Luray</i>	4/5/74	8/23/99	Zoning
<i>Town of Shenandoah</i>	11/1/74	10/16/81	
<i>Town of Stanley</i>	2/4/77	2/3/82	
<i>Shenandoah County</i>	12/20/74	2/2/06	Zoning
<i>Town of Edinburg</i>	3/28/75	7/16/03	
<i>Town of Mount Jackson</i>	5/31/75	7/16/03	Zoning
<i>Town of New Market</i>	1/31/75	7/16/03	
<i>Town of Strasburg</i>	12/28/73	7/16/03	Zoning
<i>Town of Toms Brook</i>	1/10/75	7/16/03	
<i>Town of Woodstock</i>	6/28/74	7/16/03	
<i>Warren County</i>	7/19/74	5/1/80	Zoning
<i>Town of Front Royal</i>	6/28/74	7/15/88	Zoning
<i>City of Winchester**</i>	9/6/74	No SFHA	Zoning
*No mapped floodplain for Town of Boyce			
**City of Winchester on probation as of February 7, 2003			

Commonwealth of Virginia statutes provide cities and counties the land use authority. In particular, issues such as floodwater control are empowered through §15.2-2223 and §15.2-2280. All of the jurisdictions in the planning area with mapped floodplains have adopted a local floodplain ordinance as a requirement of participation in the NFIP. Table VI-5 shows if the community has adopted a stand alone ordinance or if it has incorporated floodplain regulations into its zoning ordinance.

Warren County's floodplain ordinance includes a requirement that buildings constructed within the floodplain be elevated to one foot above the base flood elevation. Shenandoah County limits new development in the floodplain to agricultural, recreational and accessory uses and places limits on the size of new structures.

The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. Residents of communities that participate in CRS receive a reduction in the flood insurance premium. There are ten CRS classes: class 1 requires the most credit points

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and gives the largest premium reduction; class 10 receives no premium reduction. None of the jurisdictions in this hazard mitigation plan are members of the CRS.

One of the CRS requirements is a community floodplain management plan. The Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan is intended to fulfill the CRS planning requirement should any communities decide to enter the CRS.

Comprehensive Plan / Development Trends

A community's comprehensive plan provides the future vision for the community regarding growth and development. To the extent that hazard mitigation principles are addressed in the Northern Shenandoah Valley's communities' Comprehensive Plans, it generally is in the context of floodplain protection or steep slope protection.

Clarke County

In 1960, the first elements of the Zoning Ordinance were established. In 1980, the County implemented a unique form of zoning regulation for its rural areas by assigning a limited number of "Dwelling Unit Rights" to every parcel. In 1992, the County and the Town of Berryville adopted site specific land use regulations to provide for additional residential, commercial, and light industrial uses in an annexation area that doubled the area and population of the Town to 1,700 acres and 7,000 people.

The twin objectives of these actions are to retain land for agricultural use and to concentrate homes, services, and jobs. Keeping land for agriculture is key to maintaining its important role in the local economy as well as preserving the natural character the County has enjoyed since its inception. Concentrating development activities allows for the most efficient use of public facilities and services including, roads, schools, and water and sewer service (Clarke County Planning Department).

According to the 2005 Mountain Land Plan, development trends over the past 24 years show proportionately more construction activity in the Mountain Land Area of the County, where 57% of the dwelling unit rights remain unused when compared to the agricultural portion of the Valley, west of the Shenandoah River, where 68% of the dwelling unit rights remain unused. The plan includes recommendations to protect extreme slopes and areas of slippage soils from development, to the maximum extent possible.

The Mountain Land Plan acknowledges that the rugged topography, inaccessibility, lack of access to water, and forest cover, makes ensuring mountain residents protection from fire a difficult task. The plan notes that homeowners can take preventative measures to reduce the risk of fire to their homes. The plan also discusses road design standards necessary for emergency vehicle access.

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Frederick County

The 2003 Comprehensive Policy Plan seeks to protect and improve the living environment within Frederick County. Through the implementation of the plan, the county seeks to manage growth in a flexible yet coordinated way. The County has implemented a number of growth management tools; most significant is an Urban Development Area (UDA). The UDA is a growth management tool which effectively divides the County into rural and urban areas. The UDA defines the general area in which more intensive forms of residential development will occur.

According to the 2005 Land Use Annual Report, the annual population growth has maintained an average rate of 2.6% since 1990. According to population projections since the 2000 census, Frederick County is now the fifteenth (15th) fastest growing county in the Commonwealth. The 860 residential lots were created via subdivision; the majority of the lots were in the residential performance area not the rural area. The draft Rural Areas Study suggests that development in rural areas is increasing. A key component of the plan is the concept of “Green Infrastructure” which identifies critical areas for conservation including floodplains, steep slopes and sinkholes.

The County created a Conservation Easement Authority in 2005 to oversee and administer the County’s Conservation Easement Program. This program establishes a mechanism for the County to accept donated easements on land with conservation value. Once granted, the easement prohibits certain activities outright and strictly limits the potential for commercial or residential development on the eased property.

Page County

The 2001 Page County Comprehensive Plan focuses on the intent to maintain rural character and preserve its agricultural and historical heritage. The 2001 Comprehensive Plan is being updated, but the focus will remain the same, with more guided direction as to the best practices to manage growth in a manner that is conducive to the overall goals of Comprehensive Plan. The goals, in general, focus on the preservation of historic resources and county heritage, protecting natural, rural and open space, enhance the environmental quality, create a diverse and viable local economy, protection and enhancement of fiscal resources, and providing efficient public services.

In efforts to achieve these goals, the County is taking proactive approaches to preservation through innovation. The county’s ordinances have been and will continue to be monitored for effectiveness in applying and achieving the County’s vision. Some examples of the direction Page County is gravitating towards are major changes within the Floodplain

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Ordinance, a rewrite of the Zoning Ordinance to better reflect the vision of the Comprehensive Plan, and the creation of a Master Land Use Plan, which will include Area Growth Plans for the Towns within the County. There are more methods that the county will continue to strive to create and improve upon as the County takes a more efficient and effective approach to managed growth and preservation in the coming decades.

Shenandoah County

According to the Comprehensive Plan, the general land use patterns of the County have not changed greatly since first being surveyed in the 1970's. The County is largely rural with almost 85% of the land in an undeveloped state. The George Washington - Jefferson National Forest accounts for almost 24 percent of the entire land area of the County and will basically be preserved in its natural state.

The predominant land use is agriculture. However, the major types of developed uses--residential, commercial, and industrial--increased considerably over the last several decades. The plan estimates that the amount of developed land more than doubled between 1988 and 2002.

The Comprehensive Plan states "there has been concentrated growth in and around the towns and the Bryce Mountain service area where public facilities are available and it was possible to construct several types of housing, including townhouses and apartments, as well as commercial and industrial uses. Outside of those areas, the growth has been primarily residential on large lots with individual on-site water and septic systems, and has been scattered throughout the County along rural secondary roads."

The six incorporated towns in the County are located in a linear pattern running northeast and southwest along Old Valley Pike (U.S. Route 11). There has been a strong second home/retirement home market in Shenandoah County for the last several decades.

The comprehensive plan recognizes the development constraints of steep slopes and floodplains, noting that areas located in the later should be considered for parks or other recreational uses.

Warren County

The first Warren County Comprehensive Plan was adopted in 1975 and has been updated four times. Warren County adopted its first zoning ordinance in 1973. Its first subdivision ordinance was adopted in 1981. Since initial adoptions of these development ordinances, there have been many subsequent amendments. The zoning ordinance was completely revised in 1992.

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Many of the plan's objectives address protection of sensitive areas such as floodplains and karst areas. These objectives would likely be complementary to hazard mitigation. One of the plan's objectives is to "protect the important natural function of rivers, streams, and floodplains by encouraging appropriate use and preservation of natural vegetation." Another objective is to "develop performance standards for karst and other sensitive areas." In addition, a key component of the plan is growth management and ensuring that growth occurs in a pattern that allows for efficient and serviceable form.

Three major factors have greatly influenced the County's growth and development: its beauty; its location; and its proximity to major cities. Because of the ease of travel along its length, the Valley has been an important North-South transportation route since Indian times.

According to the Comprehensive Plan, Warren County experienced a growth rate of 48.9% between 1980 and 2000. Much of this growth occurred in the Happy Creek District, located in the northeast portion of the County. It is expected to reach a population of 43,993 by 2020; this represents a 39% increase. One aspect of this growth is the increased number of households which reflects the national trend in decreasing average household sizes.

As stated in the Comprehensive Plan, Warren County's development pattern is characteristic of a rural County on the fringe of an expanding metropolitan area. Generally, the majority of the County is characterized by crop land, forests, and a scattering of farms, single-family residences, or neighborhoods. Crossroads communities, various size villages and development mixes, are located throughout the County. There are several large-lot subdivisions in the County's rural areas as well as mountain recreational subdivisions which have been converted to full time residences in and around Linden. Outside of these concentrations, development has occurred in a random fashion along the County's highways. Residential development is expected to continue to dominate growth in the County and is expected to be concentrated in the northeast portion of the County.

The majority of the County's commercial development is concentrated along U.S. Route 522/340 north and VA Route 55. Industrial uses are limited to the U.S. Route 522/340 north corridor and the Happy Creek Industrial Park.

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Table VI-5 catalogs the various plans in place in the jurisdictions of the Northern Shenandoah Valley.

Table VI-5. Availability of Plans and their Support for Hazard Mitigation							
Jurisdiction	Clarke Co.	Frederick Co.	Town of Stephens City	Page Co.	Town of Luray	Town of Shenandoah	Town of Stanley
<i>Hazard Mitigation Plan</i>	In progress	In progress	In progress	In progress	In progress	In progress	In progress
<i>Comp. Plan</i>	✓*	✓	✓	✓*	✓*	✓	✓
<i>Open Space Mgmt. Plan</i>	✓	✓	✓***	✓*		✓	✓
<i>Capital Imp. Plan</i>	✓	✓	✓	✓*		✓	✓
<i>Econ. Dev. Plan</i>		✓		✓*	✓		
<i>Hist. Prsv. Plan</i>	✓	✓	✓	✓*			
<i>Floodplain Mgmt. Plan</i>	✓		✓***	✓*	✓	✓	✓
<i>Stormwater Mgmt. Plan</i>		✓	In progress	✓*		✓	
<i>Flood Response Plan</i>		✓		✓	✓	✓	
<i>Emergency Operations Plan</i>	✓	✓	✓	✓	✓	✓	✓
<i>Cont. of Operations Plan</i>	✓	✓	✓	✓		In progress	
<i>Evacuation Plan</i>	✓	✓	Part of EOP	✓	✓		✓
<i>Disaster Recovery Plan</i>	✓	✓	Part of EOP	In progress	✓		
<i>SARA Title III Plan</i>		✓		✓			✓
<i>Radiological Rep. Plan</i>		✓		✓			

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Table VI-5. Availability of Plans and their Support for Hazard Mitigation

Jurisdiction	Shenandoah Co.	Town of Edinburg	Town of Mount Jackson	Town of New Market	Warren Co.	Town of Front Royal	City of Winchester
<i>Hazard Mitigation Plan</i>	In progress	In progress	In progress	In progress	In progress	In progress	In progress
<i>Comp. Plan</i>	✓	✓	✓	✓	✓	✓	✓
<i>Open Space Mgmt. Plan</i>	✓				In progress	✓	✓
<i>Capital Imp. Plan</i>	✓	✓	✓	✓	✓	✓	✓
<i>Econ. Dev. Plan</i>					✓	✓	✓
<i>Hist. Prsv. Plan</i>		In progress	✓	✓	✓	✓	✓
<i>Floodplain Mgmt. Plan</i>			✓		✓	✓	✓
<i>Stormwater Mgmt. Plan</i>			✓		✓	✓	✓
<i>Flood Response Plan</i>						✓	✓
<i>Emergency Operations Plan</i>	✓		✓**		✓	✓	✓
<i>Cont. of Operations Plan</i>	✓		✓**		✓	✓	✓
<i>Evacuation Plan</i>	✓		✓**		✓	✓	✓
<i>Disaster Recovery Plan</i>	✓		✓**		✓	✓	✓
<i>SARA Title III Plan</i>	✓		✓**		✓	✓	✓
<i>Radiological Rep. Plan</i>	✓		✓**		✓	✓	✓

*Under review but older plan is currently in place; ** Included in County plan; ***No plan but ordinance exists

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Legal Authority

Local governments in Virginia have a wide range of tools available to them for implementing mitigation programs, policies and actions. A hazard mitigation program can utilize any or all of the four broad types of government powers granted by the Commonwealth of Virginia, which are (a) regulation, (b) acquisition, (c) taxation, and (d) spending. The scope of this local authority is subject to constraints, however, as all of Virginia's political subdivisions must not act without proper delegation from the commonwealth. All power is vested in the commonwealth and can only be exercised by local governments to the extent it is delegated. Thus, this portion of the capability assessment will summarize Virginia's enabling legislation which grants the four types of government powers listed above within the context of available hazard mitigation tools and techniques.

Regulation

General Police Power

Virginia's local governments have been granted broad regulatory powers in their jurisdictions. Commonwealth of Virginia Statutes bestow the general police power on local governments, allowing them to enact and enforce ordinances which define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people, and to define and abate nuisances (including public health nuisances). Since hazard mitigation can be included under the police power (as protection of public health, safety and welfare), towns, cities, and counties may include requirements for hazard mitigation in local ordinances. Local governments also may use their ordinance-making power to abate "nuisances," which could include, by local definition, any activity or condition making people or property more vulnerable to any hazard.

All of the jurisdictions in the planning area have enacted and enforce regulatory ordinances designed to promote the public health, safety, and general welfare of its citizenry.

Land Use

Regulatory powers granted by the state to local governments are the most basic manner in which a local government can control the use of land within its jurisdiction. Through various land use regulatory powers, a local government can control the amount, timing, density, quality, and location of new development. All these characteristics of growth can determine the level of vulnerability of the community in the event of a natural hazard. Land use regulatory powers include the power to engage in planning, enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls. Each local community possesses the power to prevent or limit unsuitable development in hazard-prone areas.

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Planning

According to Commonwealth Statutes, local governments in Virginia may create or designate a planning agency. The planning agency may perform a number of duties, including:

- ❖ Make studies of the area;
- ❖ Determine objectives;
- ❖ Prepare and adopt plans for achieving those objectives;
- ❖ Develop and recommend policies, ordinances, and administrative means to implement plans; and
- ❖ Perform other related duties.

The importance of the planning powers of local governments is illustrated by the requirement that zoning regulations be made in accordance with a comprehensive plan. While the ordinance itself may provide evidence that zoning is being conducted “in accordance with a plan,” the existence of a separate planning document ensures that the government is developing regulations and ordinances that are consistent with the overall goals of the community. All of the jurisdictions within the planning area have planning departments and comprehensive plans.

Zoning

Zoning is the traditional and most common tool available to local governments to control the use of land. Broad enabling authority is granted for municipalities and counties in Virginia to engage in zoning. Land “uses” controlled by zoning include the type of use (e.g., residential, commercial, and industrial) as well as minimum specifications that control height and bulk such as lot size, building height and set backs, and density of population. Local governments are authorized to divide their territorial jurisdiction into districts, and to regulate and restrict the erection, construction, reconstruction, alteration, repair or use of buildings, structures, or land within those districts. Districts may include general use districts, overlay districts, and special use districts. Zoning ordinances consist of maps and written text.

All of the primary jurisdictions in the planning area are implementing floodplain regulations via the zoning ordinance. An overlay district is used to impose additional requirements on properties within the designated floodplain area.

Subdivision Regulations

Subdivision regulations control the division of land into parcels for the purpose of building development or sale. Flood-related subdivision controls typically require that sub-dividers install adequate drainage facilities and design water and sewer systems to minimize flood damage and contamination. They also may prohibit the subdivision of land subject to

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flooding unless flood hazards are overcome through filling or other measures, and they prohibit filling of floodway areas.

All of the counties in the planning area and the City of Winchester have adopted a subdivision ordinance. All of the ordinances contain flood-specific provisions. For instance, Frederick County requires that when land is subdivided, an easement be placed on the area encompassing the area of the 100-year flood. The subdivision ordinance also requires that all building floor elevations shall be a minimum of two feet above the one-hundred-year floodplain elevation.

Building Codes and Building Inspection

Many structural mitigation measures involve constructing and retrofitting homes, businesses and other structures according to standards designed to make the buildings more resilient to the impacts of natural hazards. Many of these standards are imposed through building codes. All of the jurisdictions have adopted the Uniform Virginia Building Code.

Local governments in Virginia also are empowered to carry out building inspections. It empowers cities and counties to create an inspection department, and enumerates their duties and responsibilities, which include enforcing state and local laws relating to the construction of buildings, installation of plumbing, electrical, and heating systems; building maintenance; and other matters. All of the jurisdictions have established a Building Inspections Office to carry out building inspections.

Fire Codes

Virginia has a statewide fire code that is enforced by state fire marshals. The code establishes statewide standards to safeguard life and property from the hazards of fire or explosion arising from the improper maintenance of life safety and fire prevention and protection materials, devices, systems and structures. Localities may choose to adopt stricter standards and/or employ their own fire marshals. There are reciprocal agreements for fire, rescue, and law enforcement.

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Table VI-6 summarizes the various ordinances that are in effect in the jurisdictions in the planning area.

Table VI-6. Availability of Ordinances and their Support for Hazard Mitigation						
Jurisdiction	Floodplain Ord.	Zoning Ord.	Subdivision Ord.	Unified Dev. Ord.	Post-Disaster Redevelopment Ord.	Fire Code
Clarke Co.	✓	✓	✓			✓
Frederick Co.	✓	✓	✓			✓
Town of Stephens City	✓	✓	✓			
Page Co.	✓	✓	✓	In progress		✓
Town of Luray	✓	✓	✓			
Town of Shenandoah	✓	✓	✓			
Town of Stanley	✓	✓	✓			
Shenandoah Co.	✓	✓	✓			✓
Town of Ediburg		✓	✓			County
Town of Mount Jackson	In progress	✓	✓			County
Town of New Market		✓	✓			County
Warren Co.	✓	✓	✓			✓
Town of Front Royal	✓	✓	✓			
City of Winchester	✓	✓	✓			✓

Acquisition

The power of acquisition can be a useful tool for pursuing local mitigation goals. Local governments may find the most effective method for completely “hazard-proofing” a particular piece of property or area is to acquire the property (either in fee simple or a lesser interest, such as an easement), thus removing the property from the private market and eliminating or reducing the possibility of inappropriate development occurring. Virginia legislation empowers cities, towns, and counties to acquire property for public purpose by gift, grant, devise, bequest, exchange, purchase, lease or eminent domain.

Acquisition has been used by Shenandoah County to acquire ten private properties within flood-prone areas of the County.

Taxation

The power to levy taxes and special assessments is an important tool delegated to local governments by Virginia law. The power of taxation extends beyond merely the collection of revenue, and can have a profound impact on the pattern of development in the community. Communities have the ability through special legislation to set preferential tax rates for areas that are more suitable for development in order to discourage development in otherwise

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hazardous areas. Local units of government also have the ability to levy special assessments on property owners for all or part of the costs of acquiring, constructing, reconstructing, extending or otherwise building or improving flood protection works within a designated area. This can serve to increase the cost of building in such areas, thereby discouraging development.

Because the usual methods of apportionment seem mechanical and arbitrary, and because the tax burden on a particular piece of property is often quite large, the major constraint in using special assessments is political. Special assessments seem to offer little in terms of control over land use in developing areas. They can, however, be used to finance the provision of necessary services within municipal or county boundaries. In addition, they are useful in distributing the costs of the infrastructure required by new development to the new property owners.

Localities in Virginia collect a 1% sales tax. In addition, all of the counties in the planning area and the City of Winchester levy property taxes. As noted in Table VI-4, Warren County and the City of Winchester also use special purpose taxes.

Spending

The fourth major power that has been delegated from the Virginia General Assembly to local governments is the power to make expenditures in the public interest. Hazard mitigation principles should be made a routine part of all spending decisions made by the local government, including the adoption of annual budgets and the Capital Improvement Plan (CIP).

A CIP is a schedule for the provision of municipal or county services over a specified period of time. Capital programming, by itself, can be used as a growth management technique, with a view to hazard mitigation. By tentatively committing itself to a timetable for the provision of capital to extend services, a community can control growth to some extent, especially in areas where the provision of on-site sewage disposal and water supply are unusually expensive.

In addition to formulating a timetable for the provision of services, a local community can regulate the extension of and access to services. A CIP that is coordinated with extension and access policies can provide a significant degree of control over the location and timing of growth. These tools also can influence the cost of growth. If the CIP is effective in directing growth away from environmentally sensitive or high hazard areas, for example, it can reduce environmental costs.

All of the primary jurisdictions in the planning area have some form of a capital improvements program.

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Political Capability

The Northern Shenandoah Valley's history of natural disasters such as the floods of 1996 makes it likely that the current and future political climates will be favorable towards supporting and advancing future hazard mitigation strategies. Political willpower to implement hazard mitigation programs should be strong. This willpower is demonstrated by the successful implementation of an acquisition and demolition project in Shenandoah County.

In general, several obstacles can make hazard mitigation difficult to implement at the local level. Desirable areas for development, such as lake or riverfront properties, are often also hazardous places to build. Local government must balance the economic benefits and demand for building in such places with the public and private costs that future disasters could inflict. In addition, in areas that are already developed, implementing mitigation actions can be costly. Part of this hazard mitigation plan's mission will be to weigh the costs and benefits of such retrofitting projects to ensure that only those that are cost-effective will be chosen.

Hazard mitigation also may not be judged as high a community priority as other projects such as a school building or utility improvement. This makes it particularly important to demonstrate how hazard mitigation should be integrated into all community decision-making as opposed to a stand-alone issue.

Summary

Much of the information in this capability assessment was provided by the jurisdictions in the planning area via a capability assessment survey. The last portion of the survey asked the jurisdictions to provide a self-assessment of their capabilities. This section of the plan has provided a more detailed analysis of their capabilities. Table VI-7 summarizes the self-reported capability assessment. As the table shows, most of the jurisdictions rate themselves as having moderate to limited capability in the various categories.

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Table VI-7. Capability Self-Assessment

<i>Jurisdiction</i>	<i>Planning Capability</i>	<i>Regulatory Capability</i>	<i>Adminis- trative and Technical Capability</i>	<i>Fiscal Capability</i>	<i>Political Capability</i>	<i>Overall Capability</i>
Clarke County	High	High	Moderate	Limited	Moderate	Moderate/High
Frederick County	High	High	High	High	High	High
Town of Stephens City	Medium	Medium	Medium	Low	Medium	Medium
Page County	Limited	Moderate	Moderate	Limited	Moderate	Moderate
Town of Luray	No information provided	No information provided	No information provided	No information provided	No information provided	No information provided
Town of Shenandoah	Moderate	High	High	Moderate	Moderate	Moderate
Town of Stanley	Moderate	Moderate	Limited	Limited	Limited	Moderate
Shenandoah County	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Town of Edinburg	Limited	Limited	Limited	Moderate	Moderate	Limited
Town of Mount Jackson	Moderate	Moderate	Moderate	Limited	Moderate	Moderate
Town of New Market	Limited	Limited	Limited	Moderate	Moderate	Limited
Warren County	High	High	Moderate	Moderate	High	Moderate/High
Town of Front Royal	Moderate	Moderate	Moderate	Limited	No information provided	No information provided
City of Winchester	Limited	Moderate	Limited	Limited	Moderate	Limited

Section VII. Mitigation Strategy

This section of the Hazard Mitigation Plan describes the most challenging part of any such planning effort – the development of a Mitigation Strategy. It is a process of:

1. Setting mitigation goals,
2. Identifying, selecting, and prioritizing mitigation alternatives, and
3. Developing a mitigation action plan.

Setting Mitigation Goals

The hazard mitigation planning process conducted by the Mitigation Advisory Committee is a typical problem-solving methodology:

- Describe the problem (Hazard Identification),
- Estimate the impacts the problem could cause (Vulnerability Assessment),
- Assess what safeguards exist that might already or could potentially lessen those impacts (Capability Assessment), and
- Using this information, determine what, if anything, can be done, and select those actions that are appropriate for the community in question (Mitigation Strategy).

After a community decides that certain risks are unacceptable and that certain mitigation actions may be achievable, the development of *goals* takes place. Goals are broad statements of ideal future conditions that are desired as an outcome of implementation of the hazard mitigation plan and are typically long-term and general in nature. *Strategies* are detailed and specific methods to achieve the goals.

The Mitigation Advisory Committee discussed goals and objectives for this plan at several points in the planning process. First, the Mitigation Advisory Committee discussed goals on June 8, 2005. On November 21, 2005, the Mitigation Advisory Committee attended another meeting to discuss the results of the hazard identification and risk assessments at which goals were discussed. The goals were finalized on January 11, 2006. These goals were broad and applicable to the region. Then, each jurisdiction determined if additional individual goals and objectives were required for their jurisdictions.

Strategies, or actions, were developed as a logical extension of the plan's goals. Most of these actions are dynamic and can change. The actions were prioritized for each jurisdiction based on past damages, existing exposure to risk, other community goals, and weaknesses identified by the local government capability assessments. The priorities differ somewhat from jurisdiction to jurisdiction. These actions have been organized into a Mitigation Action Plan for each participating jurisdiction.

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The following goals form the basis for the development of mitigation strategies and individual Mitigation Action Plans for each jurisdiction. These goals apply to the region and the individual jurisdictions.

A. Community Awareness

- A.1. Encourage leadership within the public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities as a public value.
- A.2. Establish cooperative relationships between the public, private, and non-profit sectors to enhance our preparedness, response, recovery, and mitigation for hazard events.
- A.3. Support pre-disaster mitigation and remedial efforts, should damage from a natural hazard event occur.
- A.4. Introduce hazard awareness and risk reduction principles into the community's daily activities, processes, and functions.
- A.5. Develop and implement education and outreach programs to increase public awareness of the risks associated with natural and man made hazards.
- A.6. Improve community education and communication as they relate to disaster.

B. Local Capacity

- B.1. Assess the extent of our vulnerability to natural and man-made environmental hazards.
- B.2. Enhance the capabilities of local government to lessen the impacts of future disasters.
- B.3. Improve hazard assessment information to make recommendation to discourage new development and encourage preventative measures for existing development in areas vulnerable to natural and man-made hazards.
- B.4. Leverage additional federal, non-federal, and state resources in meeting natural disaster resistance goals.
- B.5. Encourage scientific study of natural and man-made hazards and the development of data to support mitigation strategies for those hazards that are a threat to the region and localities within.

C. Property Protection

- C.1. Minimize the impact of natural and man-made hazards on property with the region and localities within and promote future disaster resistant development.
- C.2. Protect new and existing public and private infrastructure and facilities from the effects of natural and man-made hazards.
- C.3. Reduce damage to personal and public property including critical facilities.
- C.4. Identify and protect critical services, buildings, facilities and infrastructure at risk to natural and man-made hazards and undertake cost-effective mitigation measures.

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D. Public Safety

- D.1. Enhance the safety of residents and businesses by protecting new and existing development from the effects of natural and man-made hazards through efficient policies and procedures.
- D.2. Ensure public health and safety within the region and localities within before, during, and following hazardous events.
- D.3. Protect the citizens to the best of our abilities from natural and man-made environmental hazards to reduce the loss of life and personal injury.
- D.4. Create coordinated regional emergency response criteria to establish services through the use of federal, state, regional and local resources utilizing a regional reciprocating agreement.

Considering Mitigation Alternatives

The results of the Hazard Identification and Risk Assessment resulted in the generation of a range of potential mitigation goals and actions to address the hazards. A range of acceptable alternatives were then identified and provided to the Mitigation Advisory Committee for consideration. These alternatives are presented in Appendix G.

The Mitigation Advisory Committee also was provided with a copy of *Mitigation Ideas: Possible Mitigation Measures by Hazard Type* to use as a resource to identify potential mitigation actions.

Prioritizing Alternatives

The Mitigation Advisory Committee members used the STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) Criteria to select and prioritize the most appropriate mitigation alternatives for their communities. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions for the area's jurisdictions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on a jurisdiction's capabilities.

Table VII-1, below, provides information regarding the review and selection criteria for alternatives.

Table VII-1. STAPLE/E Review and Selection Criteria for Alternatives	
Social	
<ul style="list-style-type: none">• Is the proposed action socially acceptable to the community(s)?• Are there equity issues involved that would mean that one segment of a community is treated unfairly?• Will the action cause social disruption?	

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Table VII-1. STAPLE/E Review and Selection Criteria for Alternatives

Technical
<ul style="list-style-type: none"> • Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other community(s) goals?
Administrative
<ul style="list-style-type: none"> • Can the community(s) implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political
<ul style="list-style-type: none"> • Is the action politically acceptable? • Is there public support both to implement and to maintain the project?
Legal
<ul style="list-style-type: none"> • Is the community(s) authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? • Are there legal side effects? Could the activity be construed as a taking? • Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? • Will the community(s) be liable for action or lack of action? • Will the activity be challenged?
Economic
<ul style="list-style-type: none"> • What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the community(s)? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other community goals, such as capital improvements or economic development? • What benefits will the action provide?
Environmental
<ul style="list-style-type: none"> • How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? • Are endangered or threatened species likely to be affected?

In formulating a mitigation strategy, a wide range of activities were considered in order to help achieve the goals and to lessen the vulnerability of the Northern Shenandoah Valley to the effects of natural hazards.

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Strategies were ranked by each community. Ranking was completed in order of relative priority based on the STAPLE/E criteria, as well as the strategy's potential to reduce vulnerability to natural hazards.

When deciding on which strategies should receive priority in implementation, the communities considered:

- Time – Can the strategy be implemented quickly?
- Ease to implement – How easy is the strategy to implement? Will it require many financial or staff resources?
- Effectiveness – Will the strategy be highly effective in reducing risk?
- Lifespan – How long will the effects of the strategy be in place?
- Hazards – Does the strategy address a high priority hazard or does it address multiple hazards?
- Post-disaster implementation – Is this strategy easier to implement in a post-disaster environment?

In addition, the anticipated level of cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For structural measures, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure. Although detailed analysis was not conducted during the mitigation action development process, these factors were of primary concern when selecting measures. For those measures, that do not result in a quantifiable reduction of damages, such as public education and outreach, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions.

On the following pages are the strategies that each jurisdiction developed for their community. The strategies are organized by goal. The counties and the City of Winchester are presented in alphabetical order followed by the towns in alphabetical order. Where strategies are numbered, this indicates their numerical ranking for that jurisdiction.

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Clarke County

A. Community Awareness

High

- Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).

Medium

- Conduct public education on the principles of “sheltering in place.”
- Educate residents and business owners about reducing possible wind-borne debris (e.g., anchoring storage sheds, moving outdoor furniture indoors, trimming trees).
- Encourage public and private water conservation plans, including consideration of rainwater catchment system.
- Work with the Virginia Department of Forestry to implement the FIREWISE program in Clarke County.

B. Local Capacity

High

- Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.

Medium

- Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at key critical public facilities.
- Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).
- Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.

C. Property Protection

High

- Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.

Medium

- Investigate critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards. Prioritize facilities in known hazard areas (e.g., floodplains).

Low

- Identify program of corrective actions to improve stormwater systems’ capacity to handle major rain events.

D. Public Safety

High

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- Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.

Medium

- Continue to enforce zoning and building codes to prevent/control construction within the floodplain.
- Identify and protect critical recharge zones in high risk areas.

Low

- Work with the Virginia Department of Forestry to review local zoning and subdivision ordinances to identify areas to include wildfire mitigation principles.
- Work with mobile home parks to construct community wind shelters or to identify and publicize nearby shelters for residents.
- Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.

Frederick County

A. Community Awareness

High

1. Conduct public education on the principles of “sheltering in place.”
2. Identify and educate homeowners in flood-prone areas about flood insurance and flood plain mitigation measures.
5. Work with the Virginia Department of Forestry to implement the FIREWISE program in Frederick Co.

Medium

7. Conduct emergency preparedness education campaign targeted at residents and business within dam inundation zones.

Low

18. Work with local home improvement stores to provide workshops to residents on mitigation techniques.
19. Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).
20. Work with the National Weather Service to promote the *Turn Around, Don't Drown* public education campaign.

B. Local Capacity

High

4. Develop flu annex for continuity of operations plans.

Medium

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8. Develop debris management plan.
9. Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.
10. Identify training opportunities for staff to enhance their ability to use GIS for emergency management needs.
12. Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters.
13. Investigate critical community facilities, such as county administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards. Prioritize facilities in known hazard areas (e.g., floodplains).
15. Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.

Low

16. Review and revise, if needed, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.
17. Review and revise, if needed, local floodplain ordinances. Work with the state to coordinate a Community Assistance Visit to identify potential improvements or enhancements to existing floodplain management program.

C. Property Protection

High

3. Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.

Medium

6. Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.

D. Public Safety

Medium

11. Increase flood warning capabilities, particularly as they relate to dam failure.
14. Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.

Page County

A. Community Awareness

High

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

1. Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter weather awareness day, etc.).
2. Create a multi-level education brochure and program that would be taught on different levels with regards to education within the school system as well as targeting a brochure for the residents throughout the county.

Medium

3. Create informational flyer to be handed out at the time of building permits are applied for with regard to building weather resistant homes. This flyer would be targeted to contractors and developers in a way to enhance their building project.

Low

4. Create opportunities as to how inter-departmental staff can introduce hazard reduction within the daily activities, processes and functions.
5. The County will consider participating in the *StormReady* Program sponsored by the National Weather Service.

B. Local Capacity

High

1. Propose a more restrictive Floodplain Ordinance that will effectively eliminate or minimize new development within the floodplain, floodway, and flood base.
2. Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).

Medium

3. Encourage public and private water conservation plans, including consideration of rainwater catchment system or other low impact development techniques.
4. Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.

C. Property Protection

High

1. Evaluate properties within the floodplain for possible relocation and/or buy out. In particular, target FEMA's Repetitive Loss Properties throughout the Page Valley for possible relocation and/or buy out. Work with land trusts to facilitate purchase of land.
2. Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design) Work with VDOT as needed.

Medium

3. Evaluate the potential costs versus benefits of implementing a freeboard requirement for all new structures in the 100-year floodplain.

Low

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

4. Implement a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly probable flooding).
5. Initiate discussions with public/private utility companies to discuss incorporating mitigation measures into new and pre-existing development and infrastructure repairs. Options include: anchoring heavy equipment such as electrical transformers mounted on poles using additional straps and braces; reducing camber in overhead transmission lines; and providing cover for exposed utilities.
6. Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.
7. Integrate the jurisdiction's mitigation plan into current capital improvement plans to ensure that development does not encroach on known hazard areas.
8. Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters.
9. Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.

D. Public Safety

High

1. Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed.
 - Potentially partner the Eagle or Boy Scouts for this particular project.

Medium

2. Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the county based upon population demographics with regard to density and hazardous risks.
3. Work with the Department of Forestry to implement the FIREWISE program in Page County.

Shenandoah County

A. Community Awareness

High

1. Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness information to the student bodies that can be utilized within their individual homes.

Medium

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

2. Consider participating in the *StormReady* program sponsored by the National Weather Service.
3. Distribute information packets to raise awareness regarding the risks present in the region and to provide disaster preparedness information.

Low

4. Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.
5. Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).

B. Local Capacity

High

1. Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.
2. Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.
3. Coordinate with FEMA and the state to continue program of updating the community Flood Insurance Rate Maps (FIRMs) for selected tributaries of the North Fork of the Shenandoah River.

Medium

4. Encourage public and private water conservation plans, including consideration of rainwater catchment systems or other low impact development techniques.
5. Incorporate mitigation principles into local emergency management and recovery plans.

Low

6. Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation.
7. Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.

C. Property Protection

High

1. Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.
2. Evaluate properties within the floodplain for possible elevation or acquisition. In particular, target FEMA's Repetitive Loss Properties throughout the County for possible elevation or acquisition. Work with land trusts to facilitate purchase of land.

Low

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

3. Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design)
Work with VDOT as needed.
4. Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.
5. Identify existing flood-prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.

D. Public Safety

High

1. Develop Reverse 911 system or other public notification system

Medium

2. Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed. (Possible partnering with Eagle Scout projects.)
3. Continue to administer building and zoning regulations to insure proper development within flood prone areas.
4. Work with the Virginia Department of Forestry to implement the FIREWISE program in Shenandoah County.

Warren County

A. Community Awareness

High

- Create training opportunities for departmental staff on how to introduce hazard reduction within the daily activities of government.
- Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness weeks or days.

Medium

- Create a pre-disaster family response plan to distribute to members of the community.

Low

- Expand the local emergency management committee to include private sector organizations.
- Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitigation techniques.

B. Local Capacity

High

- Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Medium

- Review the County's existing floodplain ordinance to ensure that it is meeting local needs.
- Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRM).
- Incorporate the hazard mitigation plan goals and strategies into the County's Comprehensive Plan.

Low

- Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics.

C. Property Protection

High

- Review critical community facilities such as county administrative offices, school buildings, fire stations and police stations to evaluate their resistance to natural and man-made hazards.

Low

- Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.
- Inspect and clear debris from stormwater drainage systems. Encourage VDOT, Sanitary Districts, and Property Owner Associations to execute this strategy.

D. Public Safety

High

- Based upon the community's needs and associated risks, staff the Emergency Management Office, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by County Administration.

Medium

- Continue support of the Virginia Department of Forestry's FIREWISE program.

City of Winchester

A. Community Awareness

High

1. Create an educational program and administer it throughout the community targeting residents within the City relating to all hazards including pandemic influenza.

Medium

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

2. Create a local informational brochure and distribute the brochure throughout the community to better inform the community with regard to local emergency preparedness information.
3. Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness information to the student bodies that can be utilized within their individual homes.

Low

4. Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.
5. Conduct public education program throughout the City to residents and businesses relating to the “Shelter Assignments and Management.”
6. Consider participating in the *StormReady* Program sponsored by the National Weather Service.

B. Local Capacity

High

1. Develop plans that will provide continuity of operations for Public Safety and other related disciplines.
2. Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.

Low

3. Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation.
4. Staff the Departments of Emergency Management, Public Safety and other associated departments at levels that are adequate to support Emergency Program.

C. Property Protection

Medium

1. Consider providing necessary electrical hook-ups including wiring and switches to allow ready access and connection of emergency generators to key critical public facilities.
2. Continue to develop and enhance the utilization of the Reverse 9-1-1 calling system.
3. Continue work on the development and administration of Public Education Programs to better educate and prepare the community to deal with natural and man-made disasters.

Low

4. Investigate all schools prioritizing those used as community shelters for resistance to all natural hazards.
5. Review and investigate all flood-prone areas within the 100 year floodplain area and incorporate mitigation measures where possible.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

6. Provide NOAA weather radios to all public facilities to permit ready access to weather issued weather statements.

D. Public Safety

High

1. Create training opportunities for staff to increase their knowledge and ability to use GIS for emergency management.
2. Provide National Incident Management System and Incident Command System training to all emergency response personnel and other key support personnel.

Medium

3. Inspect and clear debris from storm water drainage systems to prevent property damage from localized flooding created by blocked inlets and transmission systems.
4. Continue to administer building and zoning regulations to insure proper development within flood prone areas.

Low

5. Evaluate existing storm water systems to determine if it is adequate for existing and future flood hazards.
6. Review and modify the Emergency Operations Plan to better address the response to hazardous materials incidents by all emergency response personnel.

Town of Edinburg

A. Community Awareness

High

1. Public notification of winter and severe storm information

B. Local Capacity

High

1. Create continuity of operations plan for town utilities and services.

D. Public Safety

High

1. Install back up generator for water treatment plant and Well #1.

Low

2. Continue support of the Virginia Department of Forestry's FIREWISE program.

Town of Front Royal

A. Community Awareness

High

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

- Utilize opportunities provided by Warren County Emergency Management Department for Town staff on how to introduce hazard reduction within the daily activities of government
- Coordinate with Warren County Emergency Management Department to work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks.

Medium

- Create a pre-disaster family response plan to distribute to members of the community.

Low

- Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitigation techniques.

B. Local Capacity

High

- Develop additional GIS layers and training opportunities for Town staff to increase their knowledge and ability to use GIS for emergency management
- Coordinate with FEMA and Virginia DCR to continue program of updating and digitizing the community FIRMS

Medium

- Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics.
- Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.

C. Property Protection

High

- Continue comprehensive inspection and debris removal program for storm water drainage system

Medium

- Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.

D. Public Safety

Medium

- Based upon the community's needs and associated risks, staff Emergency Management, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by Town Administration.
- Continue support of the Virginia Department of Forestry's FIREWISE program.

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Town of Luray

A. Community Awareness

High

1. Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks (e.g., Winter Weather Week).

Medium

2. Create opportunities as to how inter-departmental staff can introduce hazard reduction within the daily activities, processes and functions.

B. Local Capacity

High

1. Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.

C. Property Protection

Low

1. Integrate the jurisdiction's mitigation plan into current capitol improvement plans to ensure that development does not encroach on known hazard areas.

D. Public Safety

Low

1. Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the county based upon population demographics with regard to density and hazardous risks.

Town of Mount Jackson

A. Community Awareness

High

1. Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (i.e., hurricane preparedness week, winter weather awareness day).
2. Conduct public education on the principles of "shelter in place".

B. Local Capacity

High

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

1. Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.
2. Develop plan for continuity of operations plan in event of pandemic flu.
3. Propose a more restrictive floodplain ordinance that will effectively eliminate or minimize development within the floodplain, floodway, and flood base.
4. Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.

D. Public Safety

Medium

1. Work with the Department of Forestry to implement the FIREWISE program in the Town of Mount Jackson.

Town of New Market

A. Community Awareness

High

1. Design an interactive, animated computer program that describes the sources of inflow and infiltration and the role citizens play in reducing the problem.
2. Provide up-to-date current weather information through local media on town's website.

C. Property Protection

High

1. Secure town water sources (wells) through the installation of perimeter fencing and electronic access

D. Public Safety

Medium

1. Work with the Department of Forestry to implement the FIREWISE program in Page County.

Town of Shenandoah

A. Community Awareness

High

1. Create opportunities as to how inter-departmental staff can introduce hazard reduction within the daily activities, processes and functions.

B. Local Capacity

High

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

1. Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.

Medium

2. Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).

Low

3. Encourage public and private water conservation plans, including consideration of rainwater catchment system or other low impact development techniques.

C. Property Protection

High

1. Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.

Low

2. Initiate discussions with public/private utility companies to discuss incorporating mitigation measures into new and pre-existing development and infrastructure repairs. Options include: anchoring heavy equipment such as electrical transformers mounted on poles using additional straps and braces; reducing camber in overhead transmission lines; and providing cover for exposed utilities.

D. Public Safety

Medium

2. Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the town based upon population demographics with regard to density and hazardous risks.

Low

3. Work with the Department of Forestry to implement the FIREWISE program in Page County.

Town of Stanley

A. Community Awareness

1. Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter weather awareness day, etc.)
2. Create informational flyer to be handed out at the time of building permits are applied for with regard to building weather resistant homes. This flyer would be targeted to contractors and developers in a way to enhance their building project.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

B. Local Capacity

1. Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).

C. Property Protection

1. Implement a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly probable flooding).
2. Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design) Work with VDOT as needed.

D. Public Safety

2. Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the town based upon population demographics with regard to density and hazardous risks.
3. Work with the Department of Forestry to implement the FIREWISE program in the Town of Stanley.
4. Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed.
 - Potentially partner with the Eagle or Boy Scouts for this particular project.

Town of Stephens City

A. Community Awareness

High

1. Conduct public education on the principles of “sheltering in place”.

Medium

2. Identify and educate homeowners in flood-prone areas about flood insurance and flood plain mitigation measures.

Low

3. Work with local home improvement stores to provide workshops to residents on mitigation techniques.

B. Local Capacity

High

1. Develop debris management plan.

Medium

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

2. Investigate critical community facilities, such as the town office; identify shelters (non-school buildings), fire and police stations, to evaluate their resistance to flood and wind hazards. Prioritize facilities in known hazard areas (e.g., floodplains)

Low

3. Review and revise, if needed, local floodplain ordinances. Work with the state to coordinate a Community Assistance Visit to identify potential improvements or enhancements to existing floodplain management program.

C. Property Protection

High

1. Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.

D. Public Safety

High

1. Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.

Regional Actions

B. Local Capacity

1. Gather additional data to improve updated hazard identification and risk analysis. Data improvements may include building footprints with building value, hazardous materials data, and natural gas transportation data.

Mitigation Action Plans

Mitigation action plans were developed for all of the regional activities and for the high priority actions for each jurisdiction. The following action plans were designed to achieve the goals and objectives identified in this multi-jurisdictional all-hazards mitigation plan. Each proposed action includes:

- (1) the appropriate category for the mitigation technique (these categories are described in Appendix E),
- (2) the hazard it is designed to mitigate,
- (3) the goal(s) it is intended to help achieve,
- (4) potential cost and funding sources, if applicable,
- (5) the agency/person assigned responsibility for carrying out the strategy, and
- (6) a target completion date.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Clarke County

The mitigation actions below represent the highest priority strategies for Clarke County.

Mitigation Action	Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.
Category	Emergency Services
Hazard	All hazards
Goal(s)	D.3
Potential Cost & Funding Sources	Depends on size of system and features selected. One estimate is \$20,000-50,000 for set-up; 10% for annual maintenance Potential funding: VDEM, Homeland Security Grant Program
Responsible Department	Communications Center
Target Completion Date	One year from plan adoption

Mitigation Action	Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.
Category	Local Capacity
Hazard	All hazards
Goal(s)	B.3, B.5
Potential Cost & Funding Sources	Minimal cost/staff time County Budget
Responsible Department	Information Technology
Target Completion Date	6 months from plan adoption

Mitigation Action	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).
Category	Public Awareness
Hazard	All hazards
Goal(s)	A5, A6
Potential Cost & Funding Sources	Minimal/staff time County budget

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Responsible Department	County Administrator
Target Completion Date	Immediately following plan adoption

Mitigation Action	Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.
Category	Public Awareness
Hazard	Flood; Winter Storm; Tornado; Thunderstorm
Goal(s)	A.6, A.5
Potential Cost & Funding Sources	Cost: Approximately \$30 per radio Funding Source: County Administrator's budget (for public facility radios)
Responsible Department	County Administrator
Target Completion Date	6 months from plan adoption

Frederick County

The mitigation actions below represent the highest priority strategies for Frederick County.

Mitigation Action	Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.
Category	Emergency Services
Hazard	Hurricane, Tornado, Winter Storm (Power Outage)
Goal(s)	C.1, C.4
Potential Cost & Funding Sources	Cost to be developed by project for each identified critical facility Funding through capital expenditures and grants
Responsible Department	Department of Public Works
Target Completion Date	June 2012

Mitigation	Develop flu annex for continuity of operations plans.
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**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Action	
Category	Local Capacity
Hazard	Pandemic Flu
Goal(s)	B.2, B.5
Potential Cost & Funding Sources	Develop in-house with existing personnel County General Fund
Responsible Department	Emergency Management
Target Completion Date	December 2006

Mitigation Action	Conduct public education on the principles of "sheltering in place."
Category	Public Awareness
Hazard	All Hazards
Goal(s)	A.5, A.6
Potential Cost & Funding Sources	Cost of media ads and flyers – approximately \$5,000 Partner with media outlets for PSA's Grant funding
Responsible Department	Emergency Management
Target Completion Date	December 2007

Mitigation Action	Work with the Virginia Department of Forestry to implement the FIREWISE program in Frederick County.
Category	Prevention
Hazard	Wildfire
Goal(s)	A.4, B.3, C.1, D.1

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Potential Cost & Funding Sources	Cost of media ads and flyers – approximately \$5,000 Partner with media outlets for PSA's Grant funding through VDOF
Responsible Department	Fire and Rescue
Target Completion Date	Initial development and implementation by December 2007 and then continue program

Mitigation Action	Identify and educate homeowners in flood-prone areas about flood insurance and flood plain mitigation measures.
Category	Public Awareness
Hazard	Flooding
Goal(s)	A.4, A.5, A.6
Potential Cost & Funding Sources	Cost of media ads and flyers – approximately \$5,000 Partner with media outlets for PSA's Partner with insurance companies for print material and flyers
Responsible Department	Emergency Management
Target Completion Date	Initial program developed and implemented by December 2007 with continuous education programs.

Page County

The mitigation actions below represent the highest priority strategies for Page County.

Mitigation Action	Propose a more restrictive Floodplain Ordinance that will effectively eliminate or minimize new development within the floodplain, floodway, and flood base.
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.2
Potential Cost & Funding Sources	N/A
Responsible	Planning & Development

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Department	
Target Completion Date	Dec. 31, 2006

Mitigation Action	Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.3
Potential Cost & Funding Sources	All costs associated with in-house mapping Cost covered by in-house budget
Responsible Department	Planning & Development; GIS Department
Target Completion Date	Dec. 31, 2006

Mitigation Action	Evaluate properties within the floodplain for possible relocation and/or buy out. In particular, target FEMA's Repetitive Loss Properties throughout the Page Valley for possible relocation and/or buy out. Work with land trusts to facilitate purchase of land.
Category	Property Protection
Hazard	Flooding
Goal(s)	C.3
Potential Cost & Funding Sources	Cost of Removal of Repetitive Loss Properties out of Floodplain FEMA Grant Programs (Flood Mitigation Assistance program; Hazard Mitigation Grant Program; Pre-Disaster Mitigation program)
Responsible Department	Health Department; Planning & Development
Target Completion Date	Dec. 31, 2011

Mitigation Action	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter weather awareness day, etc.).
Category	Public Awareness
Hazard	All hazards
Goal(s)	A5, A6
Potential Cost	Educational Research, Distribution, and Advertisement & FEMA Grant

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

& Funding Sources	Programs plus in-house programs
Responsible Department	Parks and Recreation; Health Department; Emergency Services
Target Completion Date	Dec. 31, 2008

Mitigation Action	Create a multi-level education brochure and program that would be taught on different levels with regards to education within the school system as well as targeting a brochure for the residents throughout the county.
Category	Public Awareness
Hazard	All hazards
Goal(s)	A.1, A.2
Potential Cost & Funding Sources	Educational Research, Distribution, and Advertisement FEMA Grant Programs existing In-House Programs
Responsible Department	Parks and Recreation; School Board; Health Department; Emergency Services
Target Completion Date	Dec. 31, 2008

Shenandoah County

The mitigation actions below represent the highest priority strategies for Shenandoah County.

Mitigation Action	Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency operations.
Category	Local Capacity, Property Protection
Hazard	Storms, Hurricanes, Tornados, High Winds and Flooding (power outage events).
Goal(s)	B.2, C.4
Potential Cost & Funding Sources	(To be determined)
Responsible Department	Fire & Rescue, Public Works
Target Completion	March 2007

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Date	
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Mitigation Action	Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.
Category	Local Capacity, Property Protection
Hazard	Storms, Hurricanes, Tornados, High Winds and Flooding (power outage events).
Goal(s)	B.2, C.4
Potential Cost & Funding Sources	(To be determined)
Responsible Department	Fire & Rescue, Public Works
Target Completion Date	September 2007

Mitigation Action	Create a public education program with the schools that will provide disaster preparedness information to the student bodies that can be utilized in the homes.
Category	Public Awareness
Hazard	All
Goal(s)	A.4, A.5, A.6
Potential Cost & Funding Sources	(To be determined)
Responsible Department	Fire & Rescue, School Board
Target Completion Date	June 2007

Mitigation Action	Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.
Category	Local Capacity

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Hazard	Storms, Hurricanes, Tornados, High Winds, Flooding
Goal(s)	B.2, C.1.
Potential Cost & Funding Sources	Staff cost Grant funding.
Responsible Department	Fire & Rescue, Public Works
Target Completion Date	June 2007

Mitigation Action	Coordinate with FEMA and Virginia DCR to continue program of updating the community FIRMs for selected tributaries of the North Fork Shenandoah River.
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.2, B.3
Potential Cost & Funding Sources	FEMA Cooperating Technical Partnership program
Responsible Department	Geographic Information System
Target Completion Date	June 2008

Mitigation Action	Develop a Reverse 911 system to notify the public of hazard events in their specific areas.
Category	Public Safety
Hazard	All hazards
Goal(s)	D.1, D.2
Potential Cost & Funding Sources	(To be determined.) Staff time, grant funding

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Responsible Department	Fire & Rescue
Target Completion Date	June 2009

Mitigation Action	Evaluate properties with the floodplains for possible elevation or acquisition. Target FEMA's Repetitive Loss properties. Work with land trusts to facilitate purchases.
Category	Property Protection
Hazard	Flooding
Goal(s)	C.1, C.2, C.2
Potential Cost & Funding Sources	(To be determined)
Responsible Department	Fire & Rescue, Planning & Zoning
Target Completion Date	June 2009

Warren County

The mitigation actions below represent the highest priority strategies for Warren County.

Mitigation Action	Create training opportunities for departmental staff on how to introduce hazard reduction within the daily activities of government.
Category	Local Capacity
Hazard	All hazards
Goal(s)	B.2, A.1, A.4
Potential Cost & Funding Sources	Potential cost is contingent upon funding and internal budgets.
Responsible Department	Emergency Management Department
Target Completion Date	6 months from plan adoption

Mitigation	Based upon the communities needs and associated risks, staff the Emergency
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**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Action	Management Office, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by County Administration.
Category	Local Capacity
Hazard	All hazards
Goal(s)	B.2, D.2, D.3
Potential Cost & Funding Sources	Potential cost is contingent upon funding.
Responsible Department	Individual departments/County Administration
Target Completion Date	Within 5 years of plan adoption

Mitigation Action	Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities (e.g., grants).
Category	Prevention
Hazard	All hazards
Goal(s)	B.4
Potential Cost & Funding Sources	Cost is contingent upon funding.
Responsible Department	Fire and Rescue Department, Planning Department
Target Completion Date	1 year from plan adoption

Mitigation Action	Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness weeks or days.
Category	Public Awareness
Hazard	All hazards
Goal(s)	A.5, A.6
Potential Cost & Funding Sources	Cost is contingent upon funding.
Responsible Department	Emergency Management
Target Completion	6 months from plan adoption

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Date	
Mitigation Action	Review critical community facilities such as county administrative offices, school buildings, fire stations and police stations to evaluate their resistance to natural and man-made hazards.
Category	Property Protection
Hazard	All hazards
Goal(s)	C.4
Potential Cost & Funding Sources	Cost is contingent upon funding
Responsible Department	Emergency Management, Building Inspections, Zoning
Target Completion Date	2 years from plan adoption

City of Winchester

The mitigation actions below represent the highest priority strategies for the City of Winchester.

Mitigation Action	Develop plans that will provide continuity of operations for Public Safety and other related disciplines.
Category	Public Safety
Hazard	All hazards
Goal(s)	D.1, D.4
Potential Cost & Funding Sources	\$10,000 Local General Fund Revenue, Federal and State Grant Funds as available
Responsible Department	Emergency Management, Fire & Rescue, Law Enforcement, Emergency Communications and others as services are determined
Target Completion Date	6/30/07

Mitigation Action	Provide National Incident Management and Incident Command System training to all emergency response personnel and other key support personnel. This is to be designed to be an ongoing program.
Category	Public Safety
Hazard	All hazards
Goal(s)	D.4
Potential Cost	\$20,000

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

& Funding Sources	Local General Fund Revenues as available as well as Federal and State Grant Funds as available.
Responsible Department	Emergency Management, Fire & Rescue, Law Enforcement, Zoning, Inspections and other Departments as determined
Target Completion Date	Initial 6/30/06 continuing program to include refreshers and training for new personnel

Mitigation Action	Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.
Category	Local Capacity
Hazard	Hurricane, Flood, Tornado
Goal(s)	B.2, B.5
Potential Cost & Funding Sources	\$5,000 Local General Fund Revenue and Federal and/or State Funds as Available
Responsible Department	Emergency Management and Environmental Services
Target Completion Date	2/1/07

Mitigation Action	Create an educational program and administer it throughout the community targeting residents within the City relating to all hazards including pandemic influenza.
Category	Public Awareness
Hazard	All hazards
Goal(s)	A.5, A.6, D.3
Potential Cost & Funding Sources	\$5,000 Grant Funds as available and General Fund Revenue as available
Responsible Department	Emergency Management
Target Completion Date	6/30/07

Mitigation Action	Create training opportunities for staff to increase their knowledge and ability to use GIS for emergency management.
Category	Local Capacity
Hazard	All hazards
Goal(s)	B.2, B.3

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Potential Cost & Funding Sources	\$10,000 Local General Funds as available and/or Federal and State Grant Funds as available
Responsible Department	Informational Technology, GIS and Emergency Management
Target Completion Date	3/1/07

Town of Edinburg

The mitigation actions below represent the highest priority strategies for the Town of Edinburg.

Mitigation Action	Public notification of winter and severe storm information.
Category	Community Awareness
Hazard	Winter storms, severe weather, wind, tornado
Goal(s)	A.5
Potential Cost & Funding Sources	Unknown. Establish links on the town's website to storm alerts issued by the media.
Responsible Department	General Administration
Target Completion Date	FY 07-08

Mitigation Action	Create continuity of operations plan for town utilities and services.
Category	Local Capacity
Hazard	All hazards
Goal(s)	B.1 and B.2
Potential Cost & Funding Sources	Staff time/Unknown. The plan will be created in house. Some parts of plan and responses will require purchase of equipment/supplies to allow for continued operation of the town.
Responsible Department	General administration/Public Works
Target Completion Date	FY 07-08

Mitigation	Install back up generator for water treatment plant (WTP) and Well
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**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Action	#1.
Category	Public Safety
Hazard	Winter storm, severe storm, wind, tornado, flood (extended power outage)
Goal(s)	D.2
Potential Cost & Funding Sources	Approximately \$50,000 to operate WTP and the town's largest well. Town funds from new development/water fees.
Responsible Department	Public Works
Target Completion Date	FY 06-07 (depending on funding)

Town of Front Royal

The mitigation actions below represent the highest priority strategies for the Town of Front Royal.

Mitigation Action	Utilize opportunities provided by Warren County Emergency Management Department for Town staff on how to introduce hazard reduction within the daily activities of government
Category	Community Awareness/Local Capacity
Hazard	All hazards
Goal(s)	A1, A4, B2
Potential Cost & Funding Sources	Cost determined by Warren County; Town Budget as available
Responsible Department	Individual Departments/Town Manager
Target Completion Date	As available from Warren County

Mitigation Action	Coordinate with Warren County Emergency Management Department to work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks.
Category	Public Awareness
Hazard	All hazards
Goal(s)	A5, A6
Potential Cost & Funding Sources	Cost determined by Warren County; Town Budget as available
Responsible Department	Individual Departments/Town Manager
Target	As available from Warren County

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Completion Date	
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Mitigation Action	Develop additional GIS layers and training opportunities for Town staff to increase their knowledge and ability to use GIS for emergency management
Category	Local Capacity/Property Protection
Hazard	All hazards
Goal(s)	B2, B3, C4
Potential Cost & Funding Sources	To be determined based upon identified needs; Town Budget as available and/or Federal and State Grant Funds as available
Responsible Department	Planning & Zoning; Public Works
Target Completion Date	Ongoing

Mitigation Action	Coordination with FEMA and Virginia DCR to continue program of updating and digitizing the community FIRMS
Category	Local Capacity/Property Protection
Hazard	Flooding
Goal(s)	B2, B3, C4
Potential Cost & Funding Sources	FEMA Cooperating Technical Partnership program
Responsible Department	Planning & Zoning; Public Works
Target Completion Date	June 2008

Mitigation Action	Continue comprehensive inspection and debris removal program for storm water drainage system
Category	Local Capacity/Property Protection/Public Safety
Hazard	Storms, Hurricanes, Flooding
Goal(s)	B2, C1, C2, C3, D2
Potential Cost & Funding Sources	Currently included in Department Budget
Responsible Department	Public Works
Target Completion Date	Ongoing

Town of Luray

The mitigation actions below represent the highest priority strategies for the Town of Luray.

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Mitigation Action	Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks (e.g., Winter Weather Week).
Category	Public Awareness
Hazard	All hazards
Goal(s)	A5, A6
Potential Cost & Funding Sources	Minimal/staff time Town of Luray FY budget
Responsible Department	Town Manager/Public Safety
Target Completion Date	October 2007

Mitigation Action	Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.
Category	Emergency Services
Hazard	All hazards (especially winter weather, wind)
Goal(s)	B.2, C.4
Potential Cost & Funding Sources	Cost dependent on number of generators, etc needed; Town of Luray FY Budget
Responsible Department	Town Manager/Public Safety
Target Completion Date	October 2007

Town of Mount Jackson

The mitigation actions below represent the highest priority strategies for the Town of Mount Jackson.

Mitigation Action	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (i.e., hurricane preparedness week, winter weather awareness day).
Category	Public Awareness
Hazard	All hazards
Goal(s)	D.2
Potential Cost	Minimal/staff time

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

& Funding Sources	Town budget/grants
Responsible Department	Town manager
Target Completion Date	Immediately following plan adoption

Mitigation Action	Conduct public education on the principles of “shelter in place”.
Category	Public Awareness
Hazard	All hazards
Goal(s)	A.5, A.6
Potential Cost & Funding Sources	Cost of newsletter and flyers Partner with media outlets for Public Service Announcements Grant funding
Responsible Department	Administrative
Target Completion Date	December 2007

Mitigation Action	Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.
Category	Emergency Services
Hazard	Hurricane, tornado, winter storm (power outage)
Goal(s)	C.1, C.4
Potential Cost & Funding Sources	Cost to be developed by project for each identified critical facility Funding through capital expenditures and grants
Responsible Department	Department of Public Works, Water/Sewer, Town Manager
Target Completion Date	June 2009

Mitigation Action	Develop plan for continuity of operations plan in event of pandemic flu.
Category	Local Capacity
Hazard	Pandemic Flu

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Goal(s)	B.2, B.5
Potential Cost & Funding Sources	Develop in-house with existing personnel Town General Fund
Responsible Department	Administrative
Target Completion Date	July 2007

Mitigation Action	Propose a more restrictive floodplain ordinance that will effectively eliminate or minimize development within the floodplain, floodway, and flood base.
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.2
Potential Cost & Funding Sources	N/A
Responsible Department	Town Manager
Target Completion Date	July 2007

Mitigation Action	Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.
Category	Local Capacity
Hazard	Storms, hurricanes, tornadoes, high winds, flooding
Goal(s)	B.2, C.1
Potential Cost & Funding Sources	Staff cost Grant funding
Responsible Department	County Fire and Rescue, Town Public Works
Target Completion Date	June 2007

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Town of New Market

The mitigation actions below represent the highest priority strategies for the Town of New Market.

Mitigation Action	Design an interactive, animated computer program that describes the sources of inflow and infiltration and the role citizens play in reducing the problem.
Category	Community Awareness
Hazard	Flood, sewer back-up
Goal(s)	A.5
Potential Cost & Funding Sources	2006 estimated cost: \$8,500. Chesapeake Bay Advisory Committee State House of Delegates grant
Responsible Department	General Administration
Target Completion Date	FY 07-08 (depending on funding)

Mitigation Action	Provide up-to-date current weather information through local media on town's website.
Category	Community Awareness
Hazard	Winter storm, severe weather, flood, hurricane & high wind, tornado
Goal(s)	A.5
Potential Cost & Funding Sources	Unknown. Plan to integrate local news (WHSY TV3 Harrisonburg) into town website
Responsible Department	General Administration
Target Completion Date	FY 08-09

Mitigation Action	Secure town water sources (wells) through the installation of perimeter fencing and electronic access.
Category	Property Protection
Hazard	Terrorism (foreign and domestic)
Goal(s)	C.1, C.2, C.4
Potential Cost & Funding Sources	2006 estimated cost of \$10,000/well site. Currently six wells in operations = total cost of \$60,000. Currently working with Department of Homeland Security for the installation of one (1) security fence through a grant.

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Responsible Department	Department of Public Works
Target Completion Date	FY 07-08 (depending on funding)

Town of Shenandoah

The mitigation actions below represent the highest priority strategies for the Town of Luray.

Mitigation Action	Create opportunities as to how inter-departmental staff can introduce hazard reduction within the daily activities, processes and functions.
Category	Community Awareness
Hazard	All hazards
Goal(s)	A.4
Potential Cost & Funding Sources	Potential cost is contingent upon funding and internal budgets.
Responsible Department	Town Manager/Individual departments
Target Completion Date	March 2007

Mitigation Action	Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.3
Potential Cost & Funding Sources	Cost covered by in-house budget
Responsible Department	Town Manager, Public Works
Target Completion Date	One year after plan adoption

Town of Stanley

The mitigation actions below represent the highest priority strategies for the Town of Stanley.

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Mitigation Action	Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter weather awareness day, etc.)
Category	Public Safety
Hazard	All hazards
Goal(s)	D.2
Potential Cost & Funding Sources	Educational Research, Distribution, and Advertisement & FEMA Grant Programs plus in House programs
Responsible Department	Parks and Recreation; Health Department; Emergency Services
Target Completion Date	Dec. 31, 2008

Mitigation Action	Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).
Category	Local Capacity
Hazard	Flooding
Goal(s)	B.3
Potential Cost & Funding Sources	All costs associated with in-house mapping Cost covered by in-house budget
Responsible Department	Planning & Development; GIS Department
Target Completion Date	Three years after plan adoption

Mitigation Action	Implement a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly probable to flooding).
Category	Property Protection
Hazard	Flooding
Goal(s)	C.4
Potential Cost & Funding Sources	FEMA Pre-Disaster Mitigation Grant Program; FEMA Hazard Mitigation Grant Program
Responsible Department	Town Manager/Public Works
Target Completion	Two years after plan adoption

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Date	
Mitigation Action	Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the county based upon population demographics with regard to density and hazardous risks.
Category	Public Safety
Hazard	All hazards
Goal(s)	B.2, D.2, D.3
Potential Cost & Funding Sources	Town budget
Responsible Department	Town Manager/Individual departments
Target Completion Date	Three years after plan adoption

Town of Stephens City

The mitigation actions below represent the highest priority strategies for the Town of Stephens City.

Mitigation Action	Conduct public education on the principles of “sheltering in place”.
Category	Public Awareness
Hazard	All Hazards
Goal(s)	A.5, A.6
Potential Cost & Funding Sources	Cost of media ads and flyers – approximately \$2,000 Partner with media outlets for public service announcements (PSAs) Grant funding
Responsible Department	Town Manager
Target Completion Date	One year from plan adoption

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Mitigation Action	Conduct public education on the principles of “sheltering in place”.
Category	Local Capacity
Hazard	Storms, hurricanes, tornadoes, high winds, flooding
Goal(s)	B.2, C.1
Potential Cost & Funding Sources	Staff cost Grant funding
Responsible Department	Town Public Works
Target Completion Date	One year from plan adoption

Mitigation Action	Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.
Category	Emergency Services
Hazard	Hurricane, Tornado, Winter Storm (Power Outage)
Goal(s)	C.1, C.4
Potential Cost & Funding Sources	Cost to be developed by project for each identified critical facility Funding through capital expenditures and grants
Responsible Department	Town Public Works
Target Completion Date	Three years from plan adoption

Mitigation Action	Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.
Category	Public Safety
Hazard	All hazards
Goal(s)	D.1, D.2
Potential	(To be determined.)

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Cost & Funding Sources	Staff time, grant funding
Responsible Department	Town Manager, Fire and Rescue
Target Completion Date	Three years from plan adoption

Section VIII. Plan Maintenance Procedures

The long-term success of the Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan depends in large part on routine monitoring, evaluating, and updating of the plan so that it will remain a valid tool for the communities to use.

Formal Plan Adoption

Twenty local governments in northwest Virginia participated in this planning process and formally adopted this plan by resolution of their governing board. These local governments are Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock.

The plan was completed through the coordination efforts of the Northern Shenandoah Valley Regional Commission. Sample adoption language was provided to the participating jurisdictions to facilitate the adoption process (see Appendix A).

The adoption process itself took several months, as significant coordination by the Mitigation Advisory Committee was necessary in order to 1) place the plan review and adoption on the appropriate meeting agendas in each jurisdiction, 2) produce and provide copies in official meeting packets, 3) facilitate the actual adoption, 4) collect the adoption resolutions, and 5) incorporate the adopted resolutions into the final Hazard Mitigation Plan.

Implementation

Upon adoption, the plan faces the biggest test: ***implementation***. While this plan puts forth many worthwhile and “High” priority recommendations, the decision of which action to undertake first will be the primary issue that the Northern Shenandoah Valley communities face.

Funding is always an important and critical issue. Therefore, pursuing low or no-cost high-priority recommendations may be one approach that a community chooses to take. An example of a low-cost, high-priority recommendation would be to install flood level markers on bridges to warn of high water levels.

Another implementation approach is to prioritize those actions that can be completed in a relatively short amount of time. Being able to publicize a successful project can build momentum to implement the other parts of the plan. An example of an effective but easy-to-implement strategy is to participate in the National Weather Service’s *StormReady* program.

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It is important to the long-term implementation of the plan that the underlying principles of this Hazard Mitigation Plan are incorporated into other community plans and mechanisms, such as:

- Comprehensive Plans
- Stormwater Management Plans
- Capital Improvement Program Budgeting

The members of the Mitigation Advisory Committee convened by the Northern Shenandoah Valley Regional Commission will be responsible for ensuring the integration of this hazard mitigation plan into other plans developed by their jurisdiction.

The capability assessment section of this plan provides insight into the current comprehensive plans for each community. The members of the Mitigation Advisory Committee will work with the planning department in their jurisdiction to ensure that the appropriate information from this plan is incorporated into the next update of their comprehensive plan. As a first step, the committee members will provide a copy of this hazard mitigation plan to the director of the planning department. Information from the hazard identification and risk assessment as well as mitigation goals and strategies may be directly included as a comprehensive plan element or will be included in other elements, as appropriate. In addition, the committee members will work with the planning department to ensure that plan amendments are consistent with the principles in this hazard mitigation plan.

Projects that require large investments, such as acquisition or road retrofits, are candidates for inclusion in capital improvements plans. The members of the Mitigation Advisory Committee will ensure that the department responsible for developing their jurisdiction's capital improvements plan is familiar with this hazard mitigation plan and that any large-scale projects recommended by the plan are considered for inclusion in the capital improvements plan.

Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of government and development. This integration is accomplished by a constant effort to network and to identify and highlight the multi-objective, "win-win" benefits to each program, the communities and their constituents. This effort is achieved through monitoring agendas, attending meetings, and sending memos.

Simultaneous to these efforts, it will be important to constantly monitor funding opportunities that can be utilized to implement some of the higher cost recommended actions. This will include creating and maintaining a repository of ideas on how any required

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local match or participation requirement can be met. Then, when funding does become available, the Northern Shenandoah Valley communities will be in a position to take advantage of an opportunity. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal earmarked funds, and grant programs, including those that can serve or support multi-objective applications.

With adoption of this plan, the Northern Shenandoah Valley communities commit to:

- Pursuing the implementation of the high-priority, low/no-cost recommended actions.
- Keeping the concept of mitigation in the forefront of community decision-making by identifying and stressing the recommendations of the Hazard Mitigation Plan when other community goals, plans and activities are discussed and decided upon.
- Maintaining a constant monitoring of multi-objective, cost-share opportunities to assist the participating communities in implementing the recommended actions of this plan for which no current funding or support exists.

In addition, the communities of the Northern Shenandoah Valley region remain committed to the National Flood Insurance Program. They will continue to enforce floodplain regulations and undertake other actions to remain in compliance with the program.

Maintenance

Plan maintenance requires an ongoing effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized.

The emergency management group convened by the Northern Shenandoah Valley Regional Commission to develop the hazard mitigation plan will continue to meet to monitor and update the plan. This working group will be responsible for monitoring and updating the plan; as such the working group will want to develop the following:

- Annual progress reports from each jurisdiction on its Mitigation Action Plan,
- An annual review by the working group, and
- A 5-year written update to be submitted to the Commonwealth and FEMA Region III, unless disaster or other circumstances (e.g., changing regulations) lead to a different time frame.

The Executive Director of the Northern Shenandoah Valley Regional Commission will be responsible for monitoring this plan. The working group representative from each jurisdiction will make annual updates to the Northern Shenandoah Valley Regional Commission on the progress of the implementation of their Mitigation Action Plans. The timing of the yearly reports should coincide with either the anniversary of the approval date

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of this plan or another date chosen by the committee, such as the first of the year. The annual progress reports will be reviewed by the working group who will determine what action is needed.

The working group will be responsible for evaluating the plan by setting annual measures of success and a five-year measure of success for each strategy. These indicators can be used to evaluate the progress and success of implementation of the mitigation plan. The working group can use this information to determine if corrective action is needed. In addition, the working group should review its composition annually and add members if needed.

The working group will determine at the annual meeting if an update of the plan is needed. At a minimum, the plan will be updated every five years. Factors to consider when determining if an update is necessary include:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or,
- Increased vulnerability as a result of new development (and/or annexation).
- New state/federal laws, policies, or programs
- Changes in resource availability
- Applicability of goals/objectives/strategies

A major event, such as a Presidentially-declared disaster, may trigger a need to review the plan. If such an event occurs in the Northern Shenandoah Valley, the working group will coordinate to determine how best to review and update the plan. The update of the plan will be through written changes and submissions, as the Northern Shenandoah Valley communities and the working group deem appropriate and necessary. Major changes to the plan will be submitted to the Commonwealth and to FEMA Region III.

Public notice will be given and public participation will be invited, at a minimum, through available web postings and press releases to the local media outlets, primarily newspapers and radio stations. In addition, an annual event will be held to publicize progress on implementing the mitigation plan. This event could be timed to coincide with the anniversary of a significant event or annual awareness event (i.e., Winter Weather Preparedness Week). Jurisdictions also should provide annual updates to the governing body to keep them informed about plan implementation.

Evaluation of progress can be achieved by monitoring changes in the vulnerability identified in the plan. Changes in vulnerability can be identified by noting:

- Lessened vulnerability as a result of implementing recommended actions,

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- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or,
- Increased vulnerability as a result of new development (and/or annexation).

Updates to the plan will be through written changes and submissions, as the Northern Shenandoah Valley communities and the working group deem appropriate and necessary.

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Section IX. References

Existing Mitigation Plans

- Virginia Department of Emergency Management (VDEM). *Commonwealth of Virginia's Standard Hazard Mitigation Plan* (2004)
- West Piedmont Planning District Commission (VA) Regional Hazard Mitigation Plan
- New River Valley (VA) Mitigation Plan
- Wyoming County (WV) Mitigation Plan

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 - Planning and Zoning Department 2005 Annual Land Use Report
 - Mountain Land Plan 2005 - <http://www.co.clarke.va.us/mountainareaplan.asp>
- Data, and Emergency Operations Plans provided by communities
 - Northern Shenandoah Valley Regional Commission
 - Clarke County
 - Frederick County
 - Page County
 - Shenandoah County
 - Warren County
 - City of Winchester
- ESRI data and software
- FEMA Hazards US (HAZUS-MH) software
- FEMA Flood Insurance Study
- 2003 Frederick County Comprehensive Policy Plan
 - <http://www.co.frederick.va.us/planninganddevelopment/ComprehensivePolicyPlan.htm>
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- *Warren Sentinel (1869 – present)*
9/1870, 1889, 1924, 3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972, 1975, 11/1985, 4/1992, 2/1996, 9/1996, 9/1999, 2/2000, 5/2002, 3/2003, 4/2003, 9/2003, 9/2004
- *Page News & Courier ((1911 – present)*
9/1870, 1889, 1924, 3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972, 1975, 11/1985, 4/1992, 2/1996, 9/1996, 9/1999, 2/2000, 5/2002, 3/2003, 4/2003, 9/2003, 9/2004
- *Shenandoah-Herald (1865 – 1974)*
9/1870, 1889, 1924, 3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972
- *Shenandoah Herald and Shenandoah Valley (1974 -1984)*
1975
- *Shenandoah Valley – Herald (1984 – present)*
11/1985, 4/1992, 2/1996, 9/1996
- *Shenandoah Valley (1869-1974)*
9/1870, 1889, 1924, 3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972
- *Northern VA Daily (1932 – present)*
3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972, 1975, 11/1985, 4/1992, 2/1996, 9/1996, 9/1999, 2/2000, 5/2002, 3/2003, 4/2003, 9/2003, 9/2004
- *Winchester Evening Star (1914-1980)*
9/1870, 1889, 1924, 3/1936, 10/1942, 9/1955, 1959, 9/1969, 1970, 6/1972, 10/1972, 1975
- *Winchester Star (1980 – present)*
11/1985, 4/1992, 2/1996, 9/1996, 9/1999, 2/2000, 5/2002, 3/2003, 4/2003, 9/2003, 9/2004

**Northern Shenandoah Valley Multi-Jurisdictional
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APPENDIX A – SAMPLE ADOPTION RESOLUTION

The following resolution can be used by local jurisdictions to adopt the regional hazard Mitigation Plan per FEMA requirements.

***MODEL RESOLUTION ADOPTING A NATURAL HAZARDS MITIGATION
PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES:***

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Mitigation Advisory Committee (“MAC”) comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock was convened in order to study the Northern Shenandoah Valley’s risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the MAC to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the MAC members and the consulting firm of Dewberry, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including (jurisdiction name).

NOW THEREFORE, BE IT RESOLVED by the (governing board’s name) that the Hazard Mitigation Plan dated () is hereby approved and adopted for the (jurisdiction name). A copy of the plan is attached to this resolution.

ADOPTED by the (County) this ____ day of _____, 2006.

APPROVED:

(Chairman, Board of Supervisors)

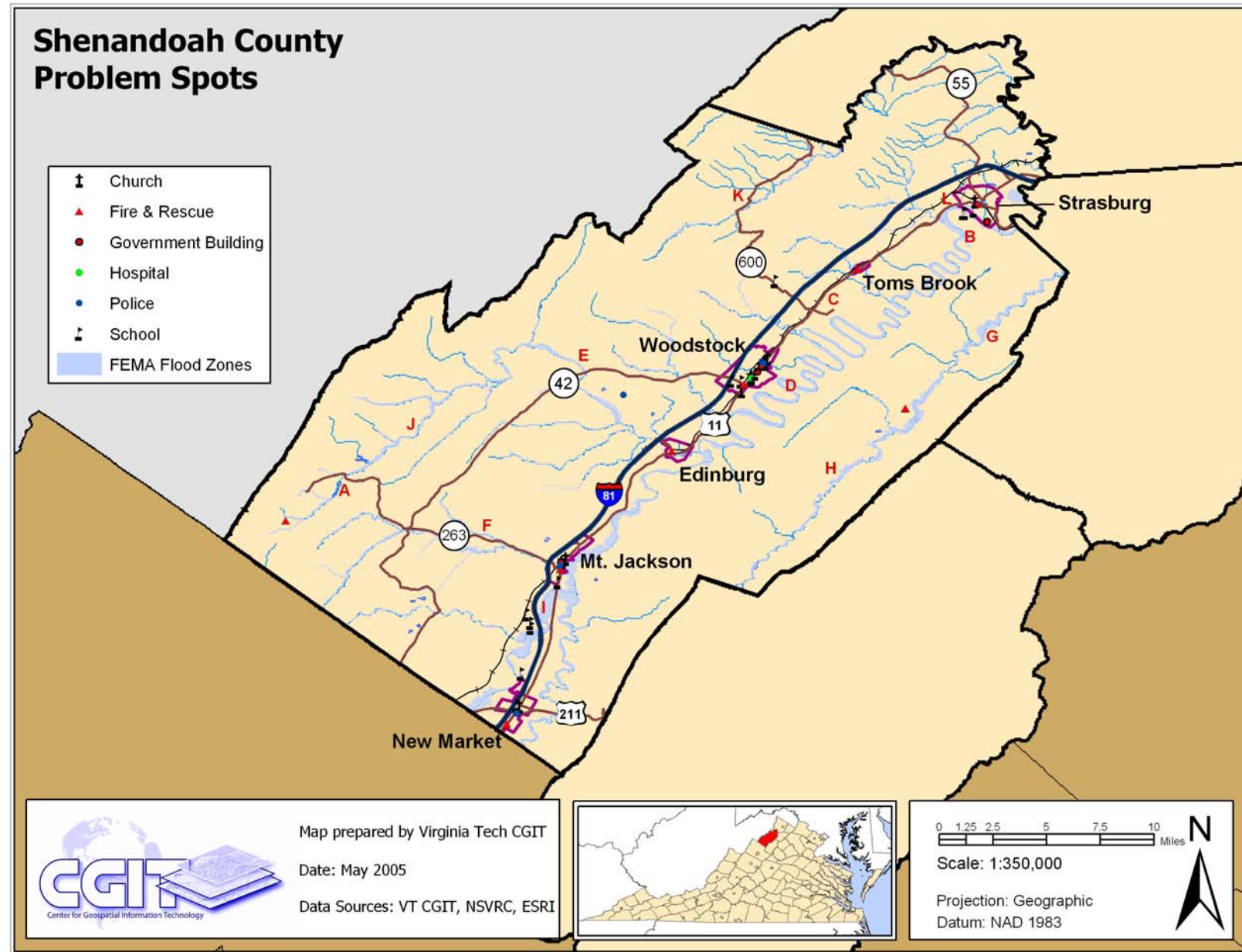
ATTEST:

**Northern Shenandoah Valley Multi-Jurisdictional
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Appendix B. Problem Spot Maps

Table B-1 Shenandoah County Flooding Problem Spots	
Map Letter	Description
A	Lake Laura: poorly designed spillway, threatens dam
B	Deer Rapids: high water closes access
C	Maurer town: high water closes Route 11
D	Leisure Point: high water floods properties
E	Columbia Furnace: road closures and flooded properties
F	Mill Creek: Road closures and flooded properties
G	Northern 678: high water closes access
H	Fort Valley: high water closes access
I	Meems Bottom: high water closes Route 11
J	Bryce: Bryce Resort susceptible to wildfire
K	Cedar Creek: flooding access
L	Fishers Hill: flooding road closures

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

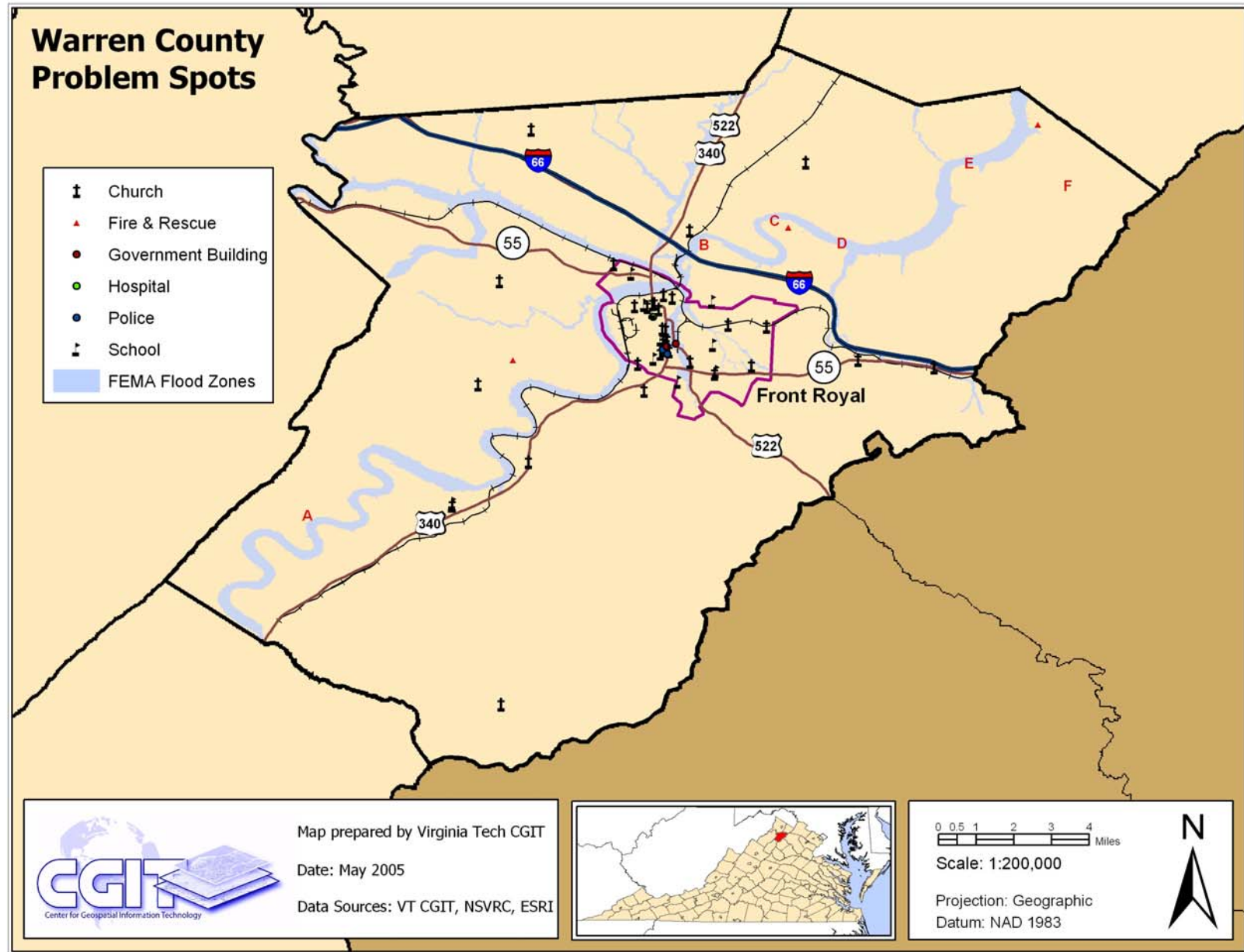


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Table B-2 Warren County Flooding Problem Spots

Map Letter	Description
A	Low water bridge
B	Shenandoah River Estates: frequent flooding
C	Shenandoah Shores: frequent flooding
D	Low water bridge
E	Shenandoah Farms: frequent flooding
F	Shenandoah Farms: washouts from flooding

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Appendix C – Hazard Histories

Table C-1. Northern Shenandoah Federal Disasters..... C-2

Table C-2. Winter Storm Hazard History 6

Table C-3. Flood Hazard History 21

Table C-4. Drought Hazard History 42

Table C-5. Hurricane & High Wind Hazard History..... 45

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Table C-7. Hazardous Material History..... 75

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Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
6/23/1972	FEMA -339- DR	Tropical Storm Agnes	This event produced devastating flooding throughout the Mid-Atlantic States. Some areas of eastern Virginia received over 15 inches of rainfall as the storm moved through. The Potomac and James Rivers experienced major flooding, which created 5 to 8 feet flood waters in many locations along the rivers. Richmond was impacted the most by these high water levels. Water supply and sewage treatment plants were inundated, as were electric and gas plants. Only one of the five bridges across the James River was open, while the downtown Richmond area was closed for several days and businesses and industries in the area suffered immense damage. Sixteen people lost their lives in the state and damage was estimated at \$222 million. These startling numbers resulted in 63 counties and 23 cities qualifying for disaster relief.
10/10/1972	FEMA -359- DR	Severe Storms & Flooding	Federal summary not available.
11/9/1985	FEMA -755- DR	Severe Storms & Flooding Election Day Flood	Heavy rainfall from October 31 through November 6, 1985, caused record-breaking floods over a large region, including western and northern Virginia. Most of the rain fell on November 4 and 5 causing flash flooding. Heavy rainfall was indirectly related to Hurricane Juan. The Roanoke River rose seven feet in one hour and 18 feet in six hours, cresting at 23 feet on November 5. There were 22 deaths in Virginia as a result of the flooding. FEMA declared 50 jurisdictions disaster areas, 1.7 million people were affected by the flooding. Flooding damages were estimated at \$800 million.
5/19/1992	FEMA -944- DR	Severe Storms & Flooding	Federal summary not available.
7/1/1995	FEMA -1059- DR	Severe Storms & Flooding	Federal summary not available.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
1/13/1996	FEMA -1086- DR	Blizzard of 1996 (Severe Storm)	Also known as the “Great Furlough Storm” due to Congressional impasse over the federal budget, the blizzard paralyzed the Interstate 95 corridor, and reached westward into the Appalachians where snow depths of over 48 inches were recorded. Several local governments and schools were closed for more than a week. The blizzard was followed with another storm, which blanketed the entire state with at least one foot of snow. To compound things, heavy snowfall piled on top of this storm’s accumulations in the next week, which kept snow pack on the ground for an extended period of time. This snow was eventually thawed by higher temperatures, and heavy rain that fell after this thaw resulted in severe flooding. Total damage between the blizzard and subsequent flooding was over \$30 million.
1/27/1996	FEMA -1098- DR	Flooding (Snow Melt)	Just one week after 2 to 4 feet of snow fell over western Virginia, temperatures warmed into the 60’s ahead of a front which brought thunderstorms and heavy rain. The sudden warm-up caused a rapid snowmelt. The melted snow was the equivalent of 2 to 4 inches of rain. Some areas saw another 2 to 5 inches of rainfall on top of the melted snow. The saturated ground meant that all the rain and snow became run off into the streams and rivers, which could not handle it. Major flooding resulted. This type of event had not happened since March 1936.
9/6/1996	FEMA -1135- DR	Hurricane Fran	This hurricane is notable not only for the \$350 million in damages it caused, but also because of its widespread effects, including a record number of people without power and the closure of 78 primary and 853 secondary roads. Rainfall amounts between 8 and 20 inches fell over the mountains and Shenandoah Valley, leading to record-level flooding in many locations within this region. 100 people had to be rescued from the flood waters, and hundreds of homes and buildings were damaged by the flood waters and high winds.

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Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
2/28/2000	FEMA -1318- DR	2000 Winter Storms	A storm that was expected to move away from the coast instead rapidly intensified off Georgia and headed almost due north. The Nor'easter spread heavy snow into Virginia during the night of the 24th and through the 25th. Storm warnings were posted for the late news on the 24th, but those who went to bed early without catching the news were startled to see the heavy white stuff falling in the morning. Several inches of snow were on the ground at daybreak, with winds gusting at 25 to 45 mph creating blizzard conditions in some areas. The region was at a stand-still. Airports and transit systems were shut down, schools were closed, and Federal, state and county government offices were closed or quickly closed once the full impact of the storm was realized. Some federal employees in Northern Virginia who begin their commutes well before the government shutdown at 7 am were left battling the storm in their attempts to return home. The heaviest band of snow fell from south central Virginia through Petersburg and the Northern Neck with a foot to a foot and a half of snow. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties. For those who did venture out on the 25th, numerous traffic accidents occurred. Virginia Beach alone recorded 84 during the storm. Strong winds pushed the tide in causing flooding of some roads. The most significant flooding was reported in the Grandview area of Hampton. Some beach erosion occurred along the shore and the U.S. Coast Guard rescued four crewmembers of a vessel caught in the rough seas off Cape Charles. Cold weather followed with the fresh snow pack and temperatures fell into the single digits in the western valleys and piedmont. One woman died of hypothermia.
5/5/2002	FEMA- 1411-DR	Severe Storms & Tornado	Federal summary not available.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
9/18/2003	FEMA-1491-DR	Hurricane Isabel	Hurricane Isabel entered Virginia September 18 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained tropical storm winds for 29 hours with some maximum winds approaching 100 mph. The hurricane produced a storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay, with rainfall totals between 2 to 11 inches along its track. Twenty-one inches of rainfall was measured near Waynesboro Virginia. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident, approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of thunderstorms and tornados came through many of the designated areas in the southeast portion of Virginia on September 23. There were a total of 36 confirmed deaths. FEMA received more than 93,000 registrations for assistance. Residential destruction included 1,186 homes reported destroyed and 9,110 with major damage, \$107,908 minor damage, with losses estimated over \$590 million. Of the 1,470 businesses involved, 77 were reported destroyed, 333 suffered major damage and 1,060 businesses suffered minor or casual damage, with losses exceeding \$84 million. FEMA Public Assistance grants exceed \$250 million and continue to increase. More than two-thirds of the households and businesses within the Commonwealth were without power. Remote locations did not have power restored for three weeks.
3/27/2003	FEMA-1458-DR	Severe Winter Storm, Snowfall, Heavy Rain, Flooding, and Mudslides	The most significant storm of the 2003-04 winter season impacting almost the entire state occurred from late February 14th through the morning hours on February 18th. Three rounds of precipitation resulted in 20 to 36 inches of snow across far northern Virginia, decreasing to between 7 and 12 inches of snow and sleet in the central part of the state, to mainly several inches of sleet and/or 1/4 to 1/2 inch of ice accretion in the south. A 24-hour snowfall of 16.7 inches at Ronald Reagan National Airport was the 5th highest on record. Charlottesville recorded almost 9 inches of sleet from the storm.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-2. Winter Storm Hazard History

Date	Damages
December 25, 1969	<p><i>(Source: The Clarke Courier and Page News and Courier)</i></p> <p>Clarke and Page Counties received 15 inches of snow with drifts 6-7 feet high. Winds were estimated at 60-70 mph. This was the worst snow storm since 1966. For this event, most secondary roads were closed and primary roads were partially open.</p> <p>Clarke County: 85 people were stranded in Berryville.</p> <p>Page County: 5 were hurt in a crash involving 3 vehicles near Grove Hill.</p>
December 13, 1995	<p>An upper-level jet streak interacted with a cold dome of arctic air to produce a mixed bag of precipitation over all of northern Virginia during the late evening of the 13th and early morning of the 14th. The precipitation began as light snow during the late afternoon of the 13th, dropping one to three inches over the central Shenandoah Valley. Warmer air aloft arrived by mid-evening, at the same time the precipitation band shifted north into extreme northern Virginia and the western suburbs of Washington. The snow changed to light freezing rain and drizzle. Although precipitation amounts were light (generally less than one-tenth of an inch), havoc was wreaked on area highways since air temperatures, and thus road temperatures, had been below freezing 72 hours prior to the onset of the precipitation.</p> <p>A thin layer of "black ice" caused nearly 1,000 accidents on Virginia highways alone, and portions of Interstates 81 (Shenandoah Valley), 66 (northern piedmont), and 95/395 (southern Washington, DC suburbs) were closed during the evening. In Shenandoah County, a tractor-semi trailer exploded after striking another rig at an entrance ramp; damage to both vehicles (and destroyed cargo) totaled nearly \$100 thousand. Two people perished in accidents, and a third died after a heart attack which followed an accident. Dozens of serious injuries occurred on northern and central Virginia highways well into the morning of the 14th. The worst accident occurred on Interstate 95 near Franconia, when an automobile with three teenagers became airborne, flipped over a guard rail, and lodged in a tree. An 18-year-old male was killed, and the two other passengers were critically injured. In Shenandoah County, a 48-year-old man was crushed to death when his car swerved ahead of an empty tour bus and struck a guard rail. The bus then struck the car, jamming it against the rail. An 80-year-old man died, also in Shenandoah County near Toms</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-2. Winter Storm Hazard History

Date	Damages
	<p>Brook, when he suffered a heart attack shortly after he stepped out of his damaged vehicle. At least 40 people sustained bone, joint, and back injuries after falling on the ice.</p>
December 19, 1995	<p>The combination of low pressure over the southern Ohio Valley, a cold high pressure ridge extending over the region from south-central Canada, and warm air aloft created significant icing over extreme northwest Virginia during the early afternoon of the 19th. Ice accretions of around one-quarter inch caused a few tree limbs and power lines to snap, producing isolated power outages over the northern half of Frederick, Clarke, and Loudoun Counties, as well as at higher elevations. The precipitation quickly turned to sleet by mid-afternoon, reducing the impact of the ice but snarling traffic nonetheless. Dulles International Airport (VAZ042) was temporarily closed in order to de-ice runways and aircraft.</p> <p>In Winchester (VAZ028), unofficial precipitation measurements indicated six-tenths liquid equivalent of freezing rain, followed by one to two inches of sleet and snow. Earlier that week (the 18th), slight accumulations of freezing rain caused numerous accidents over the northern Shenandoah Valley, with one wreck near New Market (VAZ027) causing two serious injuries.</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
January 13, 1996	<p><i>(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)</i></p> <p>On Saturday, January 6th through Monday morning, January 8th, a severe snow storm system entered Virginia producing 27 inches of snow in Berryville, 25 inches in Boyce, 30 inches in Front Royal, 24 inches in Clarke County, 36 inches in Warren County, 32 inches in Alma, 33 inches in Stanley, 38 inches in Luray, 38 inches at Shenandoah National Park, 47 inches at Big Meadows, 30 plus inches in Shenandoah County, with drifts up to 10 feet.</p> <p>Page County: 8 families were evacuated from the Skyline Lakes Subdivision near Stanley. Page County schools were out 7 days and many businesses were closed. Several trailer roofs collapsed or were sagging. Snow impacted home health care system.</p> <p>Clarke County: This snow event delayed mail delivery, closed or reduced business hours, and collapsed roofs on two businesses. Dairy farms were forced to dump milk due to delivery trucks unable to get to farms for pickups. Snow removal costs: \$18,000 estimated.</p> <p>Warren County: This event surpassed 1993's storm of the century. In March of that year, 34 inches of snow fell in 24 hours with winds up to 50 mph. For this event several subdivisions were snowed in. Shenandoah Farms residents were stranded without food and supplies. A ceiling collapsed at a tool production facility. Mail service was temporary shut down and later delayed. There were minimal power, water, sewer and phone disruptions. Campers had to be rescued from Shenandoah National Park. County snow removal costs: \$90,000 estimated.</p> <p>Shenandoah County: This event caused road problems, power and supply shortages (mostly in Woodstock), roof collapses, abandoned cars, and closed schools. Getting feed to livestock proved to be difficult.</p>
January 27, 1996	<p><i>(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)</i></p> <p>On January 27th, along with above freezing temperatures, 1.5 to 2 inches of rain fell in the region causing one of the worst flooding events in years. The Shenandoah River crested at 21 feet in Page County, 24.9 feet in Clarke County, 25 feet in Warren County, 27.83 feet in Shenandoah County</p> <p>Page County: This event produced the worst flooding in over 10 years. Melting snow and rainfall turned creeks into rivers. At one point Page County was under a high wind warning, flash flood warning, and winter weather advisory. 38 secondary roads were closed, closing all county schools. Flooded streets in Luray included Ninth Ave, Virginia Avenue, Third Street, Linden Avenue and First Street. Portions of US 340 were closed and the VA 677 bridge in Dry Run area of Luray was heavily damaged. Water from</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-2. Winter Storm Hazard History

Date	Damages
	<p>Hawksbill Creek overflowed into Mechanic Street. Raw sewage overflowed into several homes on Reservoir Avenue in Luray. Footbridges at Lake Arrowhead were washed out. Residents were evacuated in Weaver Hollow near the Page Rockingham County border. Sections of the Skyline Lakes dam were eroded</p> <p>Clarke County: Damage here was widespread. Many people outside of flood prone areas had water in their basements. One home was condemned and 58 homes were damaged, mostly with flooded basements. Recreation facilities in Watermelon Park were destroyed. Berryville's water filtration and sewage treatment plants were damaged. 21 roads in the county were submerged. Historic Burwell-Morgan mill in Millwood had \$10,000 in damages. County damage estimate: \$735,000 to homes, farming operations and businesses. Berryville estimated damages: \$70,000.</p> <p>Warren County: Melting snow plus rainfall carried debris, knocked down trees and electric poles, closed schools, and flooded homes and businesses. In Front Royal, a water line break drained 3 million gallons, flooding several roads, e.g. Commerce Ave. and Royal Ave. 200 Front Royal residents called about flooded basements and sewage backups. Flooding occurred along Happy Creek. Hardest-hit areas of the county were below where the North and South Forks of Shenandoah River converge. Subdivisions affected included Shenandoah Farms, Benny's Beach, Shenandoah River Estates, and Shenandoah Shores. 30-40 houses and structures were underwater. 7 families were evacuated. 125 Warren County residents applied for aid with FEMA.</p> <p>Shenandoah County: Rain and melting snow damaged roads and bridges, and washed out propane and fuel oil tanks from their places besides homes, in storage bins and in basements. Families were rescued from areas around Mill Creek, Stoney Creek, Edinburg and Mt. Jackson. Mt. Jackson had no drinking water. 110 county homes and Historic Edinburg Mill were severely damaged. Waters took 6 trailers from the Stoney Creek Campground in Edinburg. Large outbuildings and farm equipment were washed away. In Shenandoah County 122 roads and bridges were covered with water. Roads to Bayse were closed. Small bridge approaches were washed away and 5 swinging/footbridges were damaged. A Sinkhole occurred near Edinburg. Schools were out 8 days. 165 registered for help with FEMA. County agricultural damage was estimated at \$4.1 million from washed out roads, destroyed fences, crop loss, top soil removed, farm equipment damaged. Road damages were estimate at \$500,000 to \$3.4 million.</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-2. Winter Storm Hazard History

Date	Damages
February 2, 1996	<p>The continuation of a strong upper-level jet streak, combined with additional mid-level dynamics, generated surface low pressure over central Georgia by evening on the 2nd. As the low moved to near Cape Hatteras overnight, a broad area of heavy snow overspread all of northern Virginia. Areas that received 4 to 13 inches during an early morning event (on the 2nd) picked up an additional 4 to 6 inches, leaving most areas from the central piedmont through the northern neck with a grand total of 12 to 18 inches. Farther north, from the Shenandoah Valley through the western suburbs of Washington, DC, 6 to 9 inches fell. Circulation around the surface system allowed arctic air to pour into the area during the heaviest snowfall. Much of the snow fell at temperatures below 20 degrees, making it powdery. The 6 to 9 inches were cleared from main arteries by the next afternoon, but side streets remained snow covered. The storm's exit ushered the coldest air in two years into the region. Daytime temperatures on the 4th remained below 20 degrees, with wind chill values ranging from 10 to 20 below zero. Light winds and clear skies, combined with relatively deep snow cover, allowed temperatures to fall to as low as 18 degrees below zero over portions of the western piedmont and northern Shenandoah Valley by dawn on the 5th. Records were set on consecutive mornings at Dulles International Airport (VAZ042, eastern section), with 10 degrees below zero on the 5th and 9 below on the 6th.</p>
February 8, 1997	<p>A winter storm dumped 4 to 8 inches of heavy, wet snow across all of northern and western Virginia on the 8th. Highest totals were observed above 2500 feet, with other local maxima in the Shenandoah Valley and the western suburbs of Washington, DC. Antecedent warm weather combined with air temperatures at or just above freezing during the event, allowed roads to remain generally wet. However, icy spots developed late that afternoon and evening as temperatures fell well below freezing. The snow, which clung to everything, was aesthetically pleasing. However, the weight of the snow snapped numerous tree limbs and knocked others onto utility lines. At the peak of the storm, over 10,000 Virginia Power customers in the Washington metropolitan area alone were without electricity. Otherwise, public impact was minimal since the storm occurred on a Saturday. The storm resulted from the interaction of the subtropical jet stream, which provided a strong energy impulse to aid in lifting relatively warm humid air, with the polar jet stream, which provided enough low-level cold air to maintain wet snow rather than rain.</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
December 29, 1997	<p>A fast-moving and rapidly deepening low pressure system raced from the South Carolina coast to east of New Jersey in eight hours. An area of moderate to occasionally heavy snow developed over western North Carolina and raced through western Virginia during the afternoon and early evening. Accumulations ranged from 4 to 8 inches between the Blue Ridge and the Shenandoah Mountain range; between 8 and 14 inches in Highland County. Higher elevations throughout western Virginia received generally between 10 and 16 inches of snow. Blowing and drifting snow on the 30th created some travel headaches, but problems were minimal since the storm occurred during a period of low traffic between the Christmas and New Year's holidays. Accidents were few and far between, due to a combination of advanced warning and event time (a Monday evening). East of the Blue Ridge, a mix of snow and sleet accumulated between 1 and 4 inches, with values increasing with elevation. Minor travel problems were noted through the morning of the 30th. In the interior suburbs of Washington, DC, accumulations were generally an inch or less.</p>
January 15, 1998	<p>Warm moist air overrunning shallow polar surface air produced a variety of winter weather, starting around daybreak on the 15th and continuing just after midnight on the 16th. Precipitation began as a mix of sleet and snow but quickly changed to rain and freezing rain across much of the state. The combination of quick action by Virginia Department of Transportation road crews, and the still above freezing subsoil temperatures, kept most main arteries and secondary roads free from accumulation. However, in the ice storm area, free standing structures such as trees, power poles/wires, and exposed bridges received between 1/4 and 1/2 inch of ice accretion. A small section of higher elevation areas along and just west of the Blue Ridge received the most icing. In these areas, spotty power outages were noted, and several large limbs and small trees snapped under the weight of the ice.</p> <p>In forested areas of the northern Shenandoah Valley, specifically between 500 and 1000 feet above sea level, hundreds of trees sustained limb damage. Portions of the following counties were hit hardest: western Loudoun (VAZ042), Clarke (VAZ031), northern Warren (VAZ030), northern Shenandoah (VAZ027), and Frederick (VAZ028). Other pockets of substantial ice accretion likely occurred in Page, eastern Rockingham, and eastern Augusta Counties (VAZ025>026; 029). Power outages were rather scattered. In Clarke and Frederick Counties (VAZ028-031), three transformers blew due to ice accretion; several lines fell from the combination of fallen tree limbs and the weight of the ice. An estimated 200 Allegheny Power customers lost electricity. In the winter weather area, mixed precipitation quickly changed to rain during the late morning and early afternoon hours, but not before causing a minor build up of ice, along with early morning light coatings on area roadways.</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
January 27, 1998	<p>A winter storm developed along the Georgia coast on the 27th, then intensified as it moved slowly northward along the coast later on the 27th and 28th. The cyclone, which tracked to the Virginia capes by late afternoon on the 28th, spread a variety of winter weather across the northern and central Shenandoah Valley during a 24-hour period. As had been the case with other episodes during the 1997/98 winter, accumulations varied greatly with elevation. From the Skyline Drive to the Shenandoah Mountain and North Mountain range, accumulations ranged from around 4 inches in the valleys to 8 inches above 1500 feet. West of the Shenandoah Range, in the plateau region of Highland Co (VAZ021), accumulations ranged from 12 to 18 inches. The weight of the snow caused numerous tree limbs and some trees to fall in areas where more than one foot of snow accumulated, mainly in Highland Co. Warmer air circulating around the storm caused a rain/sleet/snow mix over the northern Shenandoah Valley, where between 1 and 3 inches of wet snow accumulated. Similar accumulations were noted along the foothills just east of the Blue Ridge.</p>
February 4, 1998	<p>A powerful nor'easter, laden with deep moisture from the Gulf of Mexico and the Caribbean, produced a prolonged period of mixed snow, sleet, freezing rain, and rain across the northwest corner of Virginia. As had been the case with previous events, snow totals varied greatly with elevation. In most of the lower terrain, between 4 and 6 inches accumulated. Local high spots, such as Harrisonburg (VAZ026) and Waynesboro (VAZ025) received between 6 and 8 inches. Elevations above 2000 feet in the Shenandoah Mountains received between 8 and 16 inches of snow. One person perished from a heart attack while shoveling snow in Harrisonburg (VAZ026). The combination of heavy wet snow, and rain falling on top of it, caused a 50 by 80 foot area of roof to collapse at a food storage and distribution center in Lynnhurst (VAZ025). Considerable damage was sustained at a home in Waynesboro when a tree, weighed down by snow and ice, fell onto the roof causing a partial collapse. In Highland Co (VAZ021), 50 roads were closed due to blowing and drifting snow; some of the drifts were as high as 6 feet. The weight of the snow caused isolated power outages. The snow changed to a cold rain in lower elevations after noon on the 4th. The combination of wet snow, an old snow pack, and moderate rains produced local street flooding in Waynesboro and Staunton (VAZ025).</p> <p>There were scattered power outages as well. In Augusta Co (VAZ025), a reported 6000 customers were without power; 3000 were due to a failed substation in Dayton. Substantial ice accretion occurred at elevations above 2000 feet as surface temperatures remained just below freezing during moderate to heavy rains. The ice was 5 inches thick in some spots. The amount of ice accretion rivaled some of the fiercest storms in the past ten years, including those of the winter of 1993/94. Shenandoah National Park officials closed Skyline Drive for at least one week after the storm. In fact, park officials, employees, and volunteers spent the remainder of February clearing trees and debris. Damage was estimated to be \$607 thousand in the Park alone. As of mid-April,</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-2. Winter Storm Hazard History

Date	Damages
	there were still hundreds of trees to remove. Tens of thousands of trees and large limbs succumbed to the weight of the ice; the road itself was under at least 10 inches of ice and sleet. Power outages, though affecting relatively few customers in the high terrain, were widespread in those areas. Other problems were noted farther north, in Clarke, Frederick, and Loudoun Counties (VAZ028-031-042). In northwestern Loudoun Co, over one hundred trees needed to be removed from local roadways; school buses were delayed in the same areas. Between 150 and 175 customers were without power in higher terrain areas of northwest Loudoun Co. In Nelson Co (VAZ036), the Wintergreen ski and recreational resort area was closed on the 5th due to ice accretion.
February 4, 1998	A powerful nor'easter, laden with deep moisture from the Gulf of Mexico and the Caribbean, produced a prolonged period of mixed snow, sleet, freezing rain, and rain across the northwest corner of Virginia. As had been the case with previous events, snow totals varied greatly with elevation. Elevations above 2,000 feet in the Shenandoah Mountains received between 8 and 16 inches of snow.
December 23, 1998	A cold front swept across Virginia on the 22nd of December, ushering in sub-freezing air that set the stage for a mixed bag of precipitation the following day. On the 23rd, a weak upper level disturbance from the Gulf States moved quickly across the Mid Atlantic region, dropping between a trace and 2 inches of snow across Northern Virginia, in addition to a thin layer of ice and sleet. The combination of mixed precipitation, holiday travelers, and the first snowstorm of the season for drivers led to many traffic accidents. Interstate 81 was also treacherous, especially between Stephens City and Winchester in Frederick County. A tractor trailer tipped over on the I-81 ramp to U.S. Route 50, closing it from 3 to 11 PM, and two people were injured in a crash at the I-81 Millwood Pike bridge.
January 2, 1999	An area of low pressure moved from the Ohio Valley to the Eastern Great Lakes on the 2nd, spreading precipitation across the Mid-Atlantic region from midday on the 2nd to early morning on the 3rd. High pressure centered over New England brought a shallow layer of sub-freezing air to locations east of the Appalachian Mountains. Closer to the mountains this layer of cold air was deep enough to allow up to 5 inches of snow to fall. Just east of the West Virginia border, this layer of cold air was shallower, forcing a majority of the precipitation to fall in the form of sleet and freezing rain. Shortly after midnight on the 3rd, a warm front from the Atlantic Ocean moved into Central and Northern Virginia. Some locations in the foothills of the Appalachian Mountains, where the rapid warmup did not occur, had problems with icy roads for several days after the storm. Schools remained closed in Warren County through the 7th due to poor driving conditions.

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Table C-2. Winter Storm Hazard History

Date	Damages
January 8, 1999	<p>An area of low pressure over Ohio brought a variety of precipitation to Northern Virginia. Precipitation started off as snow during the early morning hours of the 8th. By early afternoon warm air moved into the middle levels of the atmosphere turning the precipitation into freezing rain. The freezing rain continued through early morning on the 9th, when temperatures finally rose above freezing at the surface. Snowfall amounts included 9 to 10 inches in Highland County, 4 to 6 inches west of a line from Augusta County to Loudoun County and in Fauquier County, and 1 to 4 inches elsewhere. Ice accumulations on top of the snowfall ranged from a trace to 1/3 of an inch. The aftermath of the snow and ice included school closings and many car accidents. Over 200 traffic accidents occurred in the Washington D.C. metropolitan area leading to 27 injuries. The most serious accident occurred on the Dulles Toll Road where a jackknifed tractor trailer closed the road for an hour. Most metropolitan area schools were closed on the 8th. Interstates 66 and 81 across Northern Virginia were referred to as "treacherous" by law enforcement during the storm. Officials responded to 50 accidents along I-81 in Augusta County, mostly between mile markers 213-205 near Staunton. U.S. Route 29 was closed just south of Warrenton in Fauquier County because of a jackknifed tractor trailer and in Culpeper County due to several accidents. Snowfall up to 10 inches in Highland County made driving difficult, especially near Monterey.</p>
January 14, 1999	<p>A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. This front brought a thin layer of sub freezing air to the lowest levels of the atmosphere, but just off the surface warmer air moved in. A low pressure system developed on the 13th over the Tennessee Valley. The low moved into the Mid Atlantic region over the next few days, spreading precipitation region wide from early on the 13th through midday on the 15th. The precipitation started as snow but melted into rain as it fell through the warm layer of air in the mid levels of the atmosphere. Unfortunately west of the cold front the ground was below freezing during the period so the rain froze on every surface in came in contact with. This created ice accumulations of one quarter to one half inch north and west of a line from Loudoun County to Rockingham County through early afternoon on the 14th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County.</p> <p>The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. A 28 vehicle pileup occurred on the Dulles Toll Road in Fairfax County at 10:30 PM on the 15th, and county officials reported 62 other accidents through sunrise on the 15th. Dozens of wrecks were reported in Clarke and Winchester Counties, including an overturned truck at the intersection of Interstates 66 and 81. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. An ambulance</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
	<p>and fire truck ended up in a ditch after hitting ice in Shenandoah County. Loudoun County officials reported 37 accidents from 5 to 10 AM, including an accident that closed Snickersville Turnpike at Route 50 for two hours on the 15th. The icy conditions also led to over 500 pedestrian slip and fall injuries. One hospital in the Washington Metropolitan area treated over 250 patients alone with storm related injuries on the 15th. Winds gusted over 40 MPH after the precipitation ended and trees weighed down by the heavy ice accumulations fell on homes, across roads, and onto power lines across the area. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages. Several traffic signals across the area were out because of the power disruption through the 17th, causing additional traffic jams in the Washington D.C. suburbs.</p>
March 4, 1999	<p>A low pressure system moved from West Virginia to Pennsylvania on the evening of the 3rd. This system produced sustained winds of 25 to 40 mph from the afternoon of the 3rd through the morning of the 4th. A cold front associated with the system moved through during the early evening and produced a line of thunderstorms that brought heavy rain, small hail, and wind gusts in excess of 55 mph. In Shenandoah County, downed trees and power lines were reported across the county. 1,375 customers reported power outages. A roof was blown off an outbuilding in Fairview near Woodstock, and the top of an automated teller machine at the Strasburg Shopping Center was also blown off. Frederick County reported substantial damage to a large wall at the Rubbermaid Commercial Products Receiving Warehouse in Winchester. The wind also leveled several trees and signs. 6,000 customers reported power outages.</p> <p>The peak gust at the Winchester Airport was 42 mph. Greene County reported trees down across the county and downed electric poles near Eheart. Albemarle County reported power outages and small creeks and streams reaching bankful around 6:00 pm. Rappahannock County also reported trees down. Prince William County reported the windshield of a vehicle on Interstate 66 was blown out by high wind. In Dale City, several pine trees were also downed. After the cold front passed, temperatures dropped rapidly and rain turned to snow across Northern Virginia. Most locations received an inch or less of snow overnight, however Frederick County received 2 to 5 inches and a location on the Clark and Loudoun County line received 3 inches.</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
March 9, 1999	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Heavy snow fell across the Appalachian Mountains and the eastern foothills as the storm system moved through. In addition, the storm produced an unusual band of heavy snow that stretched in a west to east line from Frederick County to Fairfax County. This band was about 50 miles wide from north to south, and storm total snowfall was as high as one foot in this area. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. By evening on the 9th Frederick, Clarke, Loudoun, Shenandoah, and Fairfax County received between 8 and 12 inches. Warren, Page, Northern Rockingham, Rappahannock, Prince William, and northern Fauquier County received between 6 and 10 inches. In Warren County, one person was killed in a car accident on Strasburg Road. The Winchester Airport in Frederick County was closed. In Shenandoah County, an early afternoon accident involving four tractor trailers closed part of Interstate 81 for four hours.
March 14, 1999	An area of low pressure over the Southeast U.S. produced snow across much of Northern Virginia on the 14th. Snowfall amounts were heaviest near the West Virginia border. Rain mixed with snow southeast of a line from Fairfax to Orange County. The low pressure system redeveloped off the coast of North Carolina and moved up the Eastern Seaboard on the morning of the 15th, resulting in another period of snowfall. Total accumulations included 7 to 12 inches in Page County, 5 to 10 inches in Shenandoah County, 5 inches in Warren and Clarke County, and 5 to 8 inches in Frederick County. Several wrecks were reported on Interstate 81 in Shenandoah County.
January 20, 2000	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas. The first snowstorm of the season forced Washington National and Dulles International Airports to cancel one third of their morning flights. Several minor traffic accidents were reported across the region. In addition, three tractor trailers jackknifed on Interstate 81 during separate incidents in Rockingham and Augusta Counties. Snowfall totals included 3.6 inches at Washington Reagan National Airport, 5.5 inches in Warrenton, 6.0 inches in Winchester, 3.1 inches in Fredericksburg, 4.7 inches in Charlottesville, 5 to 6 inches in Monterey, 4 to 5 inches in Staunton, 4.7 inches in Boston, 4.5 inches in Stanley, 5.0 inches in Lovingson, and 4.0 inches in Harrisonburg.

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Table C-2. Winter Storm Hazard History

Date	Damages
January 25, 2000	<p>Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. Numerous traffic accidents were reported and most airports and transit systems were shut down. A few people were treated for slip and fall injuries in Fairfax County. One man in Winchester was treated for heart problems after shoveling snow. Scattered power outages were reported in Loudoun County and Alexandria. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state. Snowfall totals ranged from 1 inch near the Blue Ridge Mountains to 15 inches near the Potomac River. New daily snowfall records were set at Washington Reagan National and Dulles International Airports. Snowfall totals included 9.3 inches at National Airport, 10.3 inches at Dulles Airport, 15.0 inches in Warrenton, 12.0 inches in Fredericksburg, 5 to 6 inches in Winchester, 6.0 inches in Stanley 8.5 inches in Front Royal, 6.5 inches in Charlottesville, 5.5 inches in Waynesboro, 4.6 inches in Somerset, 7.0 inches in New Market, 4.0 inches in Sperryville, and less than 1 inch in Staunton and Harrisonburg.</p>
January 30, 2000	<p>Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 1000 power customers in Albemarle County, 125 customers in Orange County, and 3000 customers in Fredericksburg and Spotsylvania and King George Counties. A mix of sleet, freezing rain, and snow fell east of a line from Charlottesville to Arlington. Snow and sleet accumulations in this area ranged from 1 to 3 inches. West of this line, 3 to 7 inches of snow and sleet fell. Storm total accumulations included 1.2 inches at Washington Reagan National Airport, 6.4 inches at Dulles International Airport, 6.0 inches in Winchester, 9.0 inches in Luray, 6.5 inches in Warrenton, 2.5 inches in Manassas, 4.7 inches in Orange, 6.4 inches in Culpeper, 3.0 inches in Charlottesville, 6.5 inches in Staunton, and 7.0 inches in Monterey. Over 70 auto accidents were contributed to the storm, including two separate crashes in Loudoun County which killed a 59-year-old man and an 18-year-old woman. Significant flight delays were reported at National, Dulles, and Charlottesville-Albemarle Airports. Several train and bus routes were canceled or delayed. In Culpeper County, three horses suffering from hypothermia were rescued from a pond during the storm after falling through the ice.</p>

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Table C-2. Winter Storm Hazard History

Date	Damages
February 18, 2000	Low pressure tracked from the Mid-Mississippi Valley to Pennsylvania on the 18th, spreading a mixed bag of precipitation north of a line from Harrisonburg to Washington D.C. Light snow spread into the area before dawn then changed to freezing rain by mid-morning. The precipitation changed to rain across the area by early afternoon. Several traffic accidents occurred on slippery roads. Scattered power outages due to ice accumulations were also reported in Rappahannock and Fairfax Counties. Ice accumulations included one half to three quarters of an inch in Frederick and Fauquier Counties, one quarter to one half inch in Loudoun, Fairfax, Prince William, Page, Greene, Rappahannock, Culpeper, Clarke, Madison, and Shenandoah Counties, and less than one quarter inch in Rockingham and Albemarle Counties. Snowfall amounts ranged from a trace to 2 inches.
December 13, 2000	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated. Across the Shenandoah Valley and much of Northern Virginia, the ice accumulated to between one quarter and three quarters of an inch. The weight of the ice brought down some trees, branches, telephone lines, and power lines. Nearly 50,000 customers lost power across Northern Virginia for a short time. Roads were turned into sheets of ice and several traffic accidents were reported. Along the Interstate 81 corridor, law enforcement advised drivers to remain at home overnight after road conditions rapidly deteriorated. Near the Potomac River south of Washington D.C. and across the Central Piedmont, temperatures remained closed to the freezing mark so ice accumulations were less than one quarter of an inch and only caused minor inconveniences.
December 19, 2000	Low pressure moved across the region on the 19th and produced periods of light to moderate snow between 4 AM and 8 PM. Snowfall totals ranged from 2 to 6 inches with the highest amounts falling along the Blue Ridge Mountains and across the Shenandoah Valley. Several traffic accidents were reported during the evening commute after roads became snow covered. After the snow ended, northwest winds gusted up to 30 MPH which caused some of the snow to drift back onto plowed roads overnight.
January 20, 2001	A complex low pressure system moved across the Mid-Atlantic region on the 20th and 21st and brought a mixed bag of precipitation. Across the central and northern Piedmont, the precipitation fell mainly as rain but mixed with freezing rain, sleet and light snow on the 21st. Little if any accumulation was reported. Elsewhere across the northern third of Virginia, rain fell through the afternoon of the 20th but changed over the sleet and snow from west to east during the evening. Snowfall continued overnight and ended between 4 AM and noon on the 21st. Snowfall accumulations ranged from 2 to 4 inches across the Shenandoah Valley, 3 to 6 inches near the Blue Ridge and Catoctin mountain ranges, and 1 to 3 inches elsewhere. Isolated reports of thunder, snow and

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Table C-2. Winter Storm Hazard History

Date	Damages
	snow accumulation rates of one inch per hour were received. The snow and sleet caused area roads to become slippery and several traffic accidents were reported, including one incident where a man was killed on Interstate 81. Gusty northwest winds blew during the afternoon of the 21st which caused wind chills to dip to near zero and blew some snow back onto freshly plowed roads. Wind gusts included 43 MPH at Dulles International Airport and 45 MPH at Washington Reagan National Airport.
February 22, 2001	Low pressure moved from the mid Mississippi Valley into the southern portion of the Mid Atlantic region on the 22nd. This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. However, some areas received a brief period of heavy snow at the beginning of the event which created whiteout conditions. Snowfall amounts ranged from 2 to 5 inches. The highest amounts were recorded in the vicinity of the Blue Ridge Mountains. Although the snowfall accumulations were relatively minor, numerous traffic accidents were reported that involved hundreds of vehicles and numerous injuries. Six separate accidents were reported on Interstate 81 in Frederick County. Twenty accidents were reported in the City of Winchester. Frederick County school buses slid off the road around midday as they tried to take students home from school.
January 6, 2002	Low pressure moved from the Gulf Coast through the Eastern Seaboard on the 6th and brought a mixed bag of precipitation to the region. From the Blue Ridge west, the precipitation fell mainly in the form of snow with a period of sleet and freezing rain at the onset. The Shenandoah Valley received a few hours of freezing rain at the beginning of the event which resulted in several accidents. One hundred wrecks were reported on Interstate 81 between southern Rockingham County and northern Shenandoah County. Multi-car crashes temporarily closed the southbound lanes of I-81 near Mount Crawford and Woodstock. East of the Blue Ridge, a mix of rain, freezing rain, and sleet changed over to snow and sleet late in the day. In Shenandoah County, accumulations averaged around 4 inches. In Frederick County, accumulations ranged from 4.5 to 6 inches. In Page County, snow and sleet accumulations averaged around 2 inches. In Warren County, about 1.5 inches of snow and sleet was reported. In Clarke County, about 1 inch fell.
December 24, 2002	Low pressure passed directly over the region between the evening of the 24th and midday on the 25th. This system brought a mixed bag of precipitation including snow, sleet, rain, and freezing drizzle. The largest snowfall totals occurred in the Northern Shenandoah Valley and across the Northern Virginia suburbs of D.C. where between 2 and 4 inches was reported. Across the Central Shenandoah Valley, freezing drizzle and rain were the primary weather types. Patchy ice was reported on roads and sidewalks. Only a slushy inch of snow and sleet was reported. The amount of snow that fell from this storm was enough to give the region an official "White Christmas".

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Table C-2. Winter Storm Hazard History

Date	Damages
February 14, 2003	<p>A complex storm system produced copious amounts of wintry precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. The first batch of precipitation fell between the evening of the 14th and the evening of the 15th in the form of light to moderate snow or rain. The second batch of precipitation fell between midnight on the 16th through midday on the 17th in the form of heavy snow or sleet. The third batch of precipitation on the back side of the storm fell between the evening of the 17th and midday on the 18th in the form of scattered snow showers. After the precipitation came to an end, record breaking snow and sleet accumulations were reported. Across the Northern Shenandoah Valley and the northwest Virginia suburbs of Washington D.C., accumulations of mainly snow ranged from 20 to 36 inches. In Page County, a chicken house collapsed in Dovel Hollow. In Shenandoah County, two homes, one carport, 7 business buildings, 3 public buildings, and 7 agricultural buildings (including 5 animal shelters where a total of 61,000 turkeys and chickens were lost) suffered structural collapses. Twenty people who lost their homes were sheltered by the Red Cross. Near Edinburg, a 38-year-old man who was sitting in a snowbound car died of carbon monoxide poisoning. An 82-year-old man near Conicville died from a heart attack after trying to cross through deep snow to feed livestock. In Frederick County, officials reported \$1.4 million in structural losses. Four mobile homes, a park maintenance building, a commercial storage building, a barn, an industrial building, a church, and two stores suffered collapsed roofs. A nursery north of Winchester suffered the loss of 9 of 21 large greenhouses. A 76-year-old woman from Stephens City suffering from dementia was found dead from exposure a week after the storm ended buried under one foot of snow. In Clarke County, 2 hay barns and a machine shed collapsed. In Warren County, the roof of the North Warren Fire Station collapsed. Many other smaller structures including porches, garages, and carports collapsed across the county. Two men, ages 82 and 57, died of heart attacks while shoveling snow.</p>

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Table C-3. Flood Hazard History	
Date	Damages
September 1870	<p><i>(Source: The Clarke Courier and The Warren Sentinel)</i></p> <p>From September 28th to September 30th, a severe storm system entered Virginia producing heavy rains and major flooding.</p> <p>Page County: This event produced the worst flooding from the Shenandoah River. The high water mark for the Shenandoah River was 30 feet, 28 feet at Rileyville, 48 feet at Riverton and 37 feet at Castleman's Ferry Bridge. The flooding caused 12 fatalities.</p> <p>Clarke County: 23 buildings were washed away from Castleman's Ferry during this flood. Buildings included several dwellings, a tailor shop, blacksmith shop, warehouse, ice house, ferryman's house, a stable, mill and a large warehouse. This community was wiped out and didn't return.</p>
1870-1896	<p><i>(Source: The Warren Sentinel and The Clarke Courier)</i></p> <p>Page County: In 1877, The Shenandoah River high water mark was 41 feet at Riverton, 25.5 feet near Rileyville, 29.5 feet at Castleman's Ferry Bridge</p> <p>1889 (The Johnstown Flood) The Shenandoah River high water mark was 36 feet at Riverton, 29 feet at Castleman's Ferry</p> <p>1896 The Shenandoah River high water mark was 34.2 feet at Riverton, 22 feet near Rileyville</p>

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Table C-3. Flood Hazard History

Date	Damages
May 12, 1924	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Shenandoah Herald, The Winchester Evening Star and The Warren Sentinel)</i></p> <p>On Monday, May 12th, a severe storm system entered Virginia producing heavy rains continuing into Thursday, May 16th.</p> <p>City of Winchester: 8.3 inches of rain fell.</p> <p>Page County: The Shenandoah River crested at 30 feet above the low water mark at Castleman's Ferry Bridge. The high water mark of the Shenandoah River was 34.6 at Riverton, and 22 feet near Rileyville. The river rose over 15 feet at Shenandoah. The Shenandoah River washed away fences, trees, poles, livestock and roads. The Hawksbill reached a height of 7 feet at Luray; the highest in 30 years. On Water Street on the North side of the Hawksbill bridge the water reached the middle of the street. Many residents along Water Street left. Water inundated all of the cellars of the restaurants and businesses at the Hawksbill bridge. Buildings along the Hawksbill suffered the loss of minor articles. Homes were surrounded by water and several residents had to be rescued by boats. After the waters receded between 75 and 100 skeletons were found, believed to be bones of Indians. At Grove Hill estimated damages to crops was \$25,000.</p> <p>Warren County: The river crested over 34 feet. This event caused the biggest flood since 1889. The Shenandoah River flooded fields, washed away fences and topsoil, ruined crops, damaged bridges, and some livestock were lost. Both hydro-electric plants in Front Royal and Shenandoah were submerged, trains were re-routed. The county bridge over the South River was impassible and the Riverton Lime Company bridge was carried away.</p> <p>Shenandoah County: Shenandoah County was the center of the flooded region. The Shenandoah River and its' tributaries, Smith Creek, Mill Creek, Stony Creek, Pughs Run, Narrow Passage and others overflowed producing much damage that paralleled storms of 1870, 1877 and 1896. The river rose 38 feet at Strasburg</p> <p>Clarke County: Berryville was without water due to a break in pipes. Mail was suspended and trains cancelled or delayed. Water levels were at the second story level in some places.</p>

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Table C-3. Flood Hazard History

Date	Damages
May 12, 1924 (cont.)	<p>Shenandoah County: The Shenandoah River had not been this high in Mt. Jackson since 1895. The Red Banks bridge in Mt. Jackson was lifted and washed downstream making Valley Pike impassible, stranding cars. Estimated damage to this bridge \$25,000. Meem's Bottoms south of Mt. Jackson was covered with 6 feet of water. Flooding was bad at Rawley Springs where the Dry River left its banks. Cottages along Gum Creek were surrounded by water. Two floods hit Bridgewater 12 hours apart. The first flood from the North River overflowed its banks by 12 feet, the second overflowed Dry River and the Shenandoah River 8 feet over its banks. The Humston and Clinedinst county bridges, the Neff Bridge, the Snapp Bridge in the Madison district, the Santmiers bridge from Edinburg to Powells Fort, the bridge across Stony Creek and the Rude Hill Bridge were damaged. The Narrow Passage bridge was gone. Many miles of the B&O tracks between Harpers Ferry and Cumberland were suspended. Norfolk and Western rail tracks at Riverton, Grottoes and Elkton were washed away. The C&W Railroad bridge at Elkton was gone. The road from New Market Bridge was under water as far as Plains Mill. New Market was without lights. In Edinburg the Triplet power plant was swept away. Two hydro-electric plants on the Shenandoah River were damaged, one almost swept away and the other submerged and damaged. Power plants at Weyers Cave, Bridgewater and Shenandoah City were damaged. Electricity was out in Timberville electric out due to damage its' electric plant. A section of the Taylortown dam swept away. Damage to roads in the Shenandoah Valley estimated at \$500,000.</p> <p>Frederick County: At Winchester there was substantial flooding at the town library and cellars along Main Street. The northwest section of Winchester was without power. The Opequon Creek overflowed its' banks carrying debris and flooded lowlands. Railroad operations were suspended and later detoured due to washed out tracks.</p>
March 17, 1936	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Herald, The Winchester Evening Star and The Warren Sentinel)</i></p> <p>On Monday, March 17th through Tuesday, March 18th a severe storm system entered Virginia producing heavy rains, 3.69 in Winchester, and 25 feet above flood stage in Page County. The river crested at 33 feet at Castleman's Ferry by Berryville and 39 feet at Riverton. Many bridges along the Shenandoah, Potomac and Ohio Rivers washed away during this event.</p> <p>Clarke County: The Shenandoah River rose to a height of 35 feet above its normal level. Damage was primarily due to flooded cellars of homes and businesses. In Boyce, the water level reached first floor level. Farms were damaged along banks at Berry's Ferry. Travel from Boyce to Winchester and Berryville was cut off. The Castleman's Ferry bridge and the Millwood-Boyce Highway were closed to traffic. Railroad tracks at Riverton were washed out, stopping service. Electric and telephone service were interrupted for a few hours.</p>

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Table C-3. Flood Hazard History

Date	Damages
	<p>Page County: 3.10 inches of rain reported. Bridges and highways had the greatest damage. The Alma bridge across the Shenandoah River, 8 miles west of Luray was partially destroyed by floating debris, damage estimated at \$8,000. Most footbridges in the county were washed away. The banks of a new reservoir were damaged and the road to Luray High School was unfit for travel. Parts of the Eastside Highway were washed away. Several secondary roads along the Hawksbill River were covered with water. Water reached homes along this river and carried away livestock, barns and outbuildings. Many residents left their homes. Railroads (N&W and Chesapeake & Western) had heavy losses. Rail service was disrupted from several washouts. Page Power Company plants were out of commission for awhile. 15-20 electric/telephone poles fell. Most towns with the exception of Luray were without power. Crops and livestock were lost. County damage estimate: \$100,000 with \$75,000 in road damages.</p> <p>Warren County: Streets and alleys in Front Royal were flooded from Happy Creek. 50% of Main Street was flooded with many stores and cellars. The bridge between Luray and New Market and approaches to the Shenandoah River bridge at Riverton were washed away. There were mudslides on Skyline Drive between Panorama and Front Royal. The Warren Power Company plant below Riverton was 2/3 underwater. Routes 50 and 11, south of Cedar Creek along with Routes 55, 3, and 12 were damaged.</p> <p>Frederick County: The Hayfield bridge and surrounding 500 acres were flooded. Schools were dismissed. In Winchester there were washouts near Cedar Creek damaging Smith's Park and the bridge at the Norfolk & Western Rail station. Rail tracks were washed out. Mail, rail and power services were out. Almost every home and street close to the Shenandoah River had some flooding. Cedar Creek, Opequan Creek, Isaacs Creek, Hogue Creek, Parlett's Run, Mill creek at Millwood and other streams overflowed and were at their highest levels in years. Footbridges were washed out.</p> <p>Shenandoah County: Flooded houses were left with silt/sand and debris. Damages included highway washouts, downed fences telephone/electric poles and fences, small buildings and topsoil washed away. The bridge across Stoney Creek was submerged and the bridge leading to Shenandoah Caverns was washed away. The bridge across the Shenandoah River between Strasburg and Front Royal was destroyed. Several bridges north of Mt. Jackson were submerged. Farms along the Shenandoah River were hit hard. Also hard hit were Meem's Bottom, south of Mt. Jackson, Woodstock and along Spring Hollow. New Market, Mt. Jackson, Edinburg and Woodstock were without power. Part of the Woodstock Electric Light and Power Company was washed away and sections were damaged. Homes were evacuated in Woodstock and at "White Haven." In Woodstock, several footbridges over the Shenandoah River were washed away. Almost every home in Woodstock had flooded basements and one home was swept away. At Taylortown and Edinburg, hydro-electric plants were washed away. Other areas mentioned included Narrow Passage Creek, Red Banks, Mill Creek and Mt. Clinton.</p>

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Table C-3. Flood Hazard History

Date	Damages
October 13-16, 1942	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Winchester Evening Star and The Warren Sentinel)</i></p> <p>From Tuesday, October 13 to Friday, October 16, a severe storm system entered Virginia. All counties in the region had crop damage of 50% for apples.</p> <p>Clarke County: Storms produced 13.5 inches of rain, 5.34 inches in Timberville, the Shenandoah River crested at 48 feet. This event flooded crop land, houses, barns, outbuildings. Outbuildings, shacks, cabins, barns and their contents were swept away. Virtually all homes had water damage from water in basements to water reaching second floors. Orchards, livestock and farms had significant losses. Topsoil was scoured from fields leaving silt and mud. Fences and trees were toppled. Secondary roads were impassible and the bridge at Berry's Ferry was covered with water. Schools were closed two days. Mail service was interrupted and schools closed for two days. County estimated damages: \$500,000.</p> <p>Shenandoah County: Rain accumulation totaled 14 inches.</p> <p>Warren County: 16 inches of rain fell in Front Royal. This event overflowed the Shenandoah River and Happy Creek flooding acres of low-lying areas and was in the second story of many buildings. Castleman's and Berry's Ferry Bridges were under water. Front Royal was hard hit. A water main crossing Happy Creek ruptured. 450 residents along Happy Creek near Front Royal and Riverton had to be rescued. At least 45 basements were pumped of water. Telephone service, water and power were out at Front Royal. Facilities of the Front Royal Recreational Park had \$10,000 in damages. 25,000 rods of fencing damaged. High waters submerged the Luray Turnpike by Riverside, the N&W Railroad Station and the Southern Station at Riverton. This event devastated the Riverton Lime and Stone Company.</p> <p>City of Winchester: 13.41 inches fell in Winchester. Major stores and businesses were flooded. Downtown streets were flooded and the Town run overflowed. Railroads were suspended and later detoured. Almost all roads into Winchester were closed.</p> <p>Frederick County: The corn crop and livestock were heavily damaged. Schools were closed. In Winchester, The dam at Bartonsville was damaged.</p> <p>Page County: Overflowing streams and creeks washed out numerous bridges and highways. The Shenandoah River rose over the Eastside Highway to</p>

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Date	Damages
	<p>the first floor of a milling company and undermined approaches to the Alma Bridge. The Hawksbill Creek at Luray reached the highest crest on record. At the bridge in the center of town, the creek was up 17 feet, reaching the window sill of a nearby building and flooding North broad Street to a depth of 3-4 feet. Several families were homeless. Homes, livestock, businesses, outbuildings, fences, steel storage tanks, storage buildings were swept away. Heavy damage to the Main Street Bridge over the Hawksbill Creek in Luray when gas tanks washed against the bridge. Banks along this bridge were severely undermined, causing structural damage to businesses in the vicinity. Water in Luray had to be sterilized. 48' of a water main under the Main Street Bridge was washed away. Crops were severely damaged. Businesses like the restaurant at Hawksbill bridge in Luray flooded. Outbuildings at Marksville along the Pine Grove Creek were washed away in addition to portions of the road from Stony Man to Ida. Schools were closed two days. Power was out for 24 hours. County damages estimated at \$200,000 in livestock and property damages.</p> <p>Shenandoah County: This event produced major agricultural losses to crops and livestock. Houses, outbuildings, secondary roads and bridges were washed away. The bridge to Shenandoah Caverns was carried away. Sections of US 11 between New Market and Winchester were flooded along with adjacent farms in Mt. Jackson. Red Banks, near Edinburg was overflowing. Approaches of two bridges to Strasburg were swept away. New Market, Edinburg, Mt. Jackson and Woodstock were without power. At Timberville many homes and businesses were without electricity, telephone and water service. Water pipes were washed away. Livestock and crops were lost, fences were down and pastures were covered with silt and debris. Water entered homes to first floor level. Three sizeable steel bridges were carried away. Schools were closed for two days. Naked Creek flooded Verbena causing \$8,000 in damages. Shenandoah had the worst flooding from this event, knocking out power, railroad service, flooding roads and knocking homes off foundations.</p>

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Date	Damages
July 15, 1951	<p><i>(Source: Shenandoah Herald, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)</i></p> <p>Sunday evening July 15th a severe storm with high winds, hail and thunder entered the region and swept over parts of Warren, Shenandoah and Frederick Counties producing 5 inches of rain in Timberville and 2 inches in Woodstock.</p> <p>This event damaged southern and western parts of Woodstock and produced the worst flooding in years. Basements and cellars were flooded. Businesses had water damage and a barn was destroyed by fire from lightning. Trees fell and there was damage to orchards and crops. The Virginia Electric and Power Company had 10 inches of water. In Timberville, the rain washed fields, gardens and roads. In Forestville, high waters covered bridges and roads and washed away flood gates, gardens, cut wheat and trees. In the White Hall section near Winchester this event ripped roofs from buildings, twisted houses on their foundations, knocked down telephone lines and virtually destroyed farm crops in a two-mile area. Lighting caused building fires in Front Royal.</p> <p>This event affected the following towns: White Hall, Timberville, Front Royal, Forestville, Quicksburg, Conicsville and the Fort Valley section of Shenandoah east of Strasburg.</p>

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Date	Damages
October 15, 1954	<p><i>(Source: The Clarke Courier, Page News and Courier, Shenandoah Valley, The Warren Sentinel and the Winchester Evening Star)</i></p> <p>On October 15th Hurricane Hazel entered the region producing strong winds with gusts up to 40 mph and 9 inches of rain at Shenandoah National Park, 11.20 inches at Big Meadows and 4.05 inches in Winchester. High waters made roads impassible for a time.</p> <p>City of Winchester: 10-50% of the apple crops in Winchester were damaged.</p> <p>Clarke County: The Shenandoah River rose over the 6 ft marker at Bixler's Ferry Bridge, 12 to 15 feet higher than normal by Berryville. In Berryville, water flooded Main and Church Streets Approximately 15% of the apple crop reported damaged. Livestock (poultry) was also reported as a loss.</p> <p>Shenandoah County: Damage to apple orchards and livestock was reported.</p> <p>Frederick County: Approximately 15% of the apple crop reported damaged. Also reported was livestock loss, mostly poultry.</p> <p>Page County: minor and some major damage were reported. This storm caused several creeks (i.e., Hawksbill and Dry Run) to overflow, uprooting trees, knocking over fences, scouring roads and washing out parts of bridges. The Luray Sewage Treatment Plant had \$1,000 in damages from the overflowing Hawksbill Creek, which also covered US 340 north and south of Luray and carried debris. Many county roads were impassible from high waters and submerged cars. Fallen trees damaged power wires. Stanardsville had major wind damage, with fences, chimneys, antennas, and trees down with debris along the highways.</p> <p>Warren County: this storm event produced losses in livestock, mostly poultry.</p>

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Table C-3. Flood Hazard History

Date	Damages
August 12, 1955	<p><i>(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)</i></p> <p>From Thursday evening, August 11th to Saturday, August 13th, Hurricane Connie entered Virginia producing minor winds up to 30 mph and rains of 4.71 inches in Clarke County, 3.57 inches at Shenandoah National Park, 6.37 inches at Big Meadows and 6.42 inches in Winchester. The Shenandoah River rose 6 feet above its normal level.</p> <p>Clarke County: Damage from this event was fairly light. Corn, apples, peaches and trees were knocked down. Power and telephone service was disrupted. Electricity to Berryville was out for several hours. Fields, secondary roads and roads along the Shenandoah River were flooded.</p> <p>Page County: Some mountain streams reached flood stage. Rocky Branch washed out sections of roadway. Trees, crops, power lines and antennas were knocked down. There was some livestock loss.</p> <p>City of Winchester: This event knocked down trees, blocking roads and causing some power and telephone outages. There was minor crop damage. Two injured and an automobile overturned.</p>

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Table C-3. Flood Hazard History

Date	Damages
August 19, 1995	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Winchester Evening Star and The Warren Sentinel)</i></p> <p>On Wednesday evening, Hurricane Diane entered Virginia producing minor winds up to 40 mph and 2.98 inches of rain in Clarke County, 10.33 inches at the Shenandoah National Park and 11.48 inches at Big Meadows on the Skyline Drive. The Shenandoah River crested at 29 feet in Clarke County, 29 feet at the Northern & Western Bridge in Warren County, 17 feet by Luray, and 19.9 feet by Berry's Ferry on Route 50.</p> <p>City of Winchester: Winchester was cut off to west and south as main highways were underwater.</p> <p>Frederick County: Basements in Middletown were flooded. US Route 11, Route 12, Route 522, and Route 50 were closed.</p> <p>Shenandoah County: The Naked Creek caused significant damage to Verbena. One person drowned in the Shenandoah River near Strasburg. In Woodstock, a break in waterlines compromised the water system. Serious basement flooding occurred at Woodland, Opequon and Berryville Avenue in Woodstock.</p> <p>Clarke County: Since the ground was saturated from Hurricane Connie, waters flooded low lying pastures, fields and river roads. Fences were torn down and crops of corn, beans, tomatoes, and watermelons were ruined. Watermelon Park was damaged, several cabins were damaged but, with one exception, no houses were flooded. Telephone service was disrupted and the receding river left much debris. Damage was estimated in the thousands of dollars.</p> <p>Page County: 25 residents left their homes along the Hawksbill Creek. Property, livestock and highways had damage. Secondary highways were hard hit. Damaged areas cited included Shenk and Beahm Hollows by Rocky Branch, east of Luray in the Dry Run watershed and in the Ida section. Highway damage was estimated at \$50,000, not including replacing the Naked Creek bridge. Livestock damage was estimated at \$100,000. County damage estimate: \$150,000.</p> <p>Warren County: This event flooded some roads, produced minor crop damage and minor power outages. Main damage was from sewage overflow into basements. Hard hit were the Front Royal Country Club and the Guilford Electrical Contractors property near Passage Creek. Several homes were flooded in Front Royal and Riverton areas.</p>

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Table C-3. Flood Hazard History

Date	Damages
May 23, 1959	<p><i>(Source: The Clarke Courier and The Winchester Evening Star)</i></p> <p>On Saturday afternoon, May 23rd, a severe storm system entered the region producing minor rain but strong winds. This event was the second storm within a week and produced 2-3 inches of rain in northern Frederick County and 0.21 inches in Clarke County. This storm came from the northwest and swept into Clarke County, passing between Winchester and Martinsburg, WV with the worst in Stephenson, VA.</p> <p>Clarke County: This event blew off the roofs of both a house and a barn and caused damages to public utilities, trees, chimneys, and antennas. Telephone service for 200 residents was disrupted and a traffic light was out.</p> <p>Frederick County: Power and telephone services were interrupted. Lightning struck a barn at Longwood, north of Millwood. Hail smashed windows, damaged orchards and knocked down trees. Roads flooded included Route 671, Route 11, and Route 664. Noted areas of damage: White Hall, Stephenson and Burnt Factory.</p>
October 1, 1959	<p><i>(Source: The Clarke Courier, Winchester Evening Star and Warren Sentinel)</i></p> <p>On October 1, a downgraded Hurricane Gracie entered the region producing 2.03 inches of rain in Clarke County, 2.29 inches in Winchester, 2.05 in Berryville and 0.56 inches in Warren County.</p> <p>City of Winchester: This storm event produced no serious damage, however roads were temporary covered. There were minor power outages and 200 telephone lines were knocked out. No other information was provided on this event.</p>
September 23, 1969	<p><i>(Source: The Clarke Courier)</i></p> <p>On September 10th a storm system entered the region producing 3.37 inches to 4 inches of rain.</p> <p>Clarke County: Creeks and rivers overflowed their banks flooding lowlands, secondary roads and basements. Roads in White Haven and Route 7 east of Barryville were flooded.</p>

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Table C-3. Flood Hazard History

Date	Damages
<p>June 11, 1970</p>	<p><i>(Source: The Clarke Courier and Page News and Courier)</i></p> <p>A storm system entered Virginia producing 2.38 inches of rain in Clarke County and 2 inches in Page County.</p> <p>Clarke County: This event produced one of the hardest rains in years in Berryville, flooding some stores along the south side of Main Street.</p> <p>Page County: This event produced large hailstones, briefly cut power in some areas, washed through low-lying areas and flooded some basements. No major damage was reported.</p>
<p>July 10, 1970</p>	<p><i>(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)</i></p> <p>A storm system entered Virginia producing 4.28 inches of rain in Berryville, 2.55 inches in Winchester and 4 inches in Luray. The Shenandoah River rose 3 feet in Riverton.</p> <p>Clarke County: Rain flooded streets in Berryville, flooding cellars and overflowing the town run. Main Street in Berryville and Route 7 east of Berryville were blocked. A bridge on Route 522 was washed away.</p> <p>Warren County: A small tornado went through Massanutten Camp Forest near Front Royal producing \$2,000 in damages. Cedar Creek flooded roads.</p> <p>Page County: Basements were flooded, some crops and fields were damaged and roads washed out heavily in places. Several Luray Streets were flooded.</p>
<p>August 20, 1970</p>	<p><i>(Source: The Clarke Courier and Page News and Courier)</i></p> <p>A storm system entered Virginia producing 2.74 inches to 5 inches of rain in Clarke County and 4 inches in Page County.</p> <p>Clarke County: This event caused flooding in Berryville and along streams in the county. Main Street was flooded for the third time that year.</p> <p>Page County: Parts of Page county was flooded with the most damage done in Dovel Hollow near Stanley. Roads were scoured and the Hawksbill creek covered a bridge south of Luray.</p>

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Table C-3. Flood Hazard History

Date	Damages
November 14, 1970	<p><i>(Source: The Clarke Courier and The Winchester Evening Star)</i></p> <p>A storm system produced flash flooding in this region with 3.21 inches in Winchester and rising the Shenandoah River 10 feet.</p> <p>Clarke County: Basements, yards, and low lying areas were flooded. The Opequon and Cedar Creeks overflowed their banks and flooded homes. On Route 50 a car washed away and the occupant was rescued.</p> <p>City of Winchester: Two cars were swept off the road. Sensev Road had a mudslide, basements were flooded, and a restaurant was damaged. About \$20,000 in damages was done to the Izaak Walton League Park on Route 50, and the city sewer lift station was damaged. Homes along Sulphur Spring Road and Babb's Run were flooded. A few outbuildings were washed off foundations and low-lying bridges were submerged.</p>

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Table C-3. Flood Hazard History

Date	Damages
June 23, 1972	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)</i></p> <p>On June 20th through June 22nd, Hurricane Agnes entered Virginia producing 6.07 inches of rain in Clarke County, 8.15 inches at the Shenandoah National Park, 13.35 inches at Big Meadows atop the Blue Ridge, 6.55 inches in Front Royal, and 8.09 inches in Winchester.</p> <p>Clarke County: Hurricane Agnes flooded lowlands, including summer retreats at Shenandoah Farms and The Shenandoah Retreat. 50 families from Shenandoah Farms were evacuated. At this location 13 structures were destroyed. Areas with damages included White Haven, Bradfield Subdivision, Riverside Rendezvous and Watermelon Park. Many cellars were flooded. 11 roads were closed. Two were trapped on an island in Passage Creek. The receding river left much silt and debris. Losses in the county were estimated to be in the thousands of dollars. The Shenandoah River crested at 21.5 feet.</p> <p>Warren County: Areas adjacent to either fork of the Shenandoah River were underwater for days. Happy Creek, South Fork, and Passage Creek overflowed. Riverton was flooded. This event completely destroyed 21 homes, seriously damaged 150 homes, and left 50 homes with minor damage. 14 homes in Shenandoah Farms, 4-5 homes in Mandalay, 2 homes in Shenandoah Shores, 2 homes and 5 trailers at Avalon Shores in Riverton were lost to flooding. Bridges at Bentonville and Morgan's Ford were underwater. Telephone service was out. The biggest problem was backed up sewage. People got typhoid shots. There was no drinking water. County damage estimate: \$1.5 million. The Shenandoah River rose 29.56 feet in Warren County,</p> <p>Page County: This hurricane produced the worse flood in 30 years causing heavy damages to buildings, fences, roads, bridges, culverts, farmlands and crops near the Shenandoah River, the Hawksbill Creek and in low-lying areas. More than 30% of crops were damaged. Several permanent homes, vacation homes, trailers and poultry houses were damaged. Campgrounds and summer homes along the Shenandoah River were nearly covered. Residents along the Shenandoah River, Hawksbill Creek and other streams were evacuated in addition to residents of the Brookside Subdivision in East Luray. More severe damage was done to small bridges, roads, and culverts in part of the county. The Hawksbill Creek severely damaged the Linden Avenue and Dyche Bridges in Luray and carried a truck downstream. Roads in Luray and Shenk Hollow were washed out. Shenandoah's water treatment plant was out of service. Most heavily damaged section was the Pine Grove area near Stanley. There was one fatality. Luray damage estimate: \$25,000. County damage estimate: \$100,000, in farm and crop damage.</p>

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Table C-3. Flood Hazard History

Date	Damages
June 23, 1972	<p><i>Cont.</i></p> <p>Shenandoah County: This event flooded low farm lands and blocked major and secondary roads. There was some agricultural and livestock damages. Over 78 highway locations had damage from stream crossings and with debris and mudslides at several locations. Ditches were washed out and debris/silt/stone was deposited on roads. There was a large mudslide in the Zepp area of western Shenandoah County. Cedar Creek damaged a wayside and spread debris over several roads. Meem's Bottom road, Redbanks Bridge and U.S. 11 were covered. County damage estimate: \$106,000 with damage mostly on secondary roads.</p> <p>Winchester City: The Abrams Creek overflowed its banks stranding cars and flooding homes and trailer parks. 3 businesses were damaged from runoff. 200 homes were pumped. Sanitary sewers were overloaded causing backups in basements. Problem areas included Paper Mill Road, Acorn Heights, Whittier Avenue and Amherst Street.</p> <p>Frederick County: Many roads leading to the Shenandoah River and across Cedar and Opequon Creeks were closed. Low lying roads along Back Creek, Hogue Creek, Isaac Creek, and Cedar Creek were underwater. Over 200 emergency calls were reported.</p>
October 10, 1972	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, the Winchester Evening Star and the Warren Sentinel)</i></p> <p>On Thursday, October 5th through Saturday, October 7th a severe storm system entered Virginia producing 2 inches of rain in Clarke County, 7.5 to 10 inches in Page County, 1.65 inches in Warren County, and 7.65 inches at the Shenandoah National Park. The Shenandoah River crested at 27.5 feet above flood stage in Clarke County, 31 feet at Shenandoah Farms, 28.75 feet in Warren County, 21 feet in Page County, 25.55 feet at Riverton, and 21 feet above flood stage at Luray.</p> <p>Clarke County, The Shenandoah Farms area was damaged. 5 houses and 3 mobile homes were inundated with water. Monastery Road off Route 7, Castleman's Ferry Bridge, Route 638 and Route 606 were flooded. Parts of Berry's Ferry Road were washed away. Businesses were evacuated.</p> <p>Shenandoah County: Flood damage occurred in New Market, Timberville, and VA Route 953. Cabins along the Shenandoah River were flooded. High waters caused high livestock losses. Schools were closed for a day.</p> <p>Page County: 25 homes, 15-20 trailer and recreation homes, farm crops, livestock, and fences were severely damaged, in addition to heavy washing of</p>

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Date	Damages
	<p>roads and bridges throughout the county. 1000 homes had minor water damage. Hardest hit areas were in the Naked Creek section on southern part of county, Pine Grove, Mill Creek and Stony Man-Ida sections near Stanley and areas along Hawksbill Creek from Luray to Stanley. In Luray, 5 homes had water enter lower floors. Across the county several roads and bridges were closed. The Hawksbill Creek covered Linden Avenue Bridge in South Luray. The Dyché and Linden Avenue Bridges were underwater and impassable. Mudslides blocked US 211 east of Luray and on US 340 on north and south entrances to Stanley. Homes along Hollow Run were evacuated. Two separate rescues of rafters occurred along the Shenandoah River. The parking lot at Potomac Edison was flooded and water damaged sewage treatment plants at Shenandoah. Water at the Shenandoah Shores community was contaminated. Power and telephone services were briefly disrupted. County damages to farm buildings, equipment, livestock, fences and crops estimated at \$120,000</p> <p>Cont.</p> <p>Warren County: Two homes were destroyed, one at Thunderbird Ranch, the other at Avalon Shores. 100 homes and 15 trailers were damaged and left uninhabitable at Shenandoah Shores, Shenandoah Forest, Shenandoah Estates, Tranquil, Avalon, and Thunderbird. The community of Thunderbird Ranch was inaccessible due to high waters. The Happy Creek and Bentonville bridges were impassable. Routes 638, 50, and 633 were closed. The Front Royal Country Club had \$10,000 in damages. Residents were evacuated. Schools were closed for a day. County damage estimate: \$700,000 to \$800,000, which does not include road or crop damages.</p>

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Table C-3. Flood Hazard History

Date	Damages
November 9, 1985	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Warren Sentinel and The Shenandoah Valley-Herald)</i></p> <p>From Thursday, October 31st through Monday, November 4th, Hurricane Juan entered Virginia producing 5 inches in Strasburg and 6.23 in Front Royal. The Shenandoah River crested at 34.4 feet in Clarke County, 35.4 feet near Front Royal, 34.4 ft on the South Fork, 27 feet on the North Fork and 40 feet at Riverton. For this event there were two crests, one that flooded Luray and another that flooded Shenandoah County.</p> <p>Clarke County: 40 homes and weekend cabins were damaged. Buildings between Routes 7 and 50 and at Shenandoah Farms were ruined. Recreational facilities at Watermelon Park and River Park were washed away. There was significant damage on Routes 603 and 621. Over 1,000 residents had power outages. The water system was contaminated. Farmers in low lying areas lost crops, fences, livestock and farm equipment estimated at \$121,000. County damages estimate: \$850,000.</p> <p>Page County: This event rivaled the flood of 1870. Several homes, dozens of trailers, and automobiles were damaged along the Shenandoah River's South Fork, Naked Creek, Hawksbill Creek, and other areas. Naked Creek was out of its banks onto the highway. Flooding occurred in Luray, Stanley, Shenandoah, and surrounding areas. The VA Route 611 bridge over Hawksbill Creek fell into river and the VA Route 626 bridge was damaged. North of Luray residents were evacuated by helicopter. 40 miles of fences were destroyed or damaged. Crops were damaged. Power and telephone outages occurred throughout the county. In Luray, some residents were without water. 140 Page County residents registered for flood relief. County damage estimate: \$2.4 million, with \$1.8 million in private property damage and \$540,000 in public property. Damages of state routes in the county: \$445,000-\$500,000.</p> <p>Shenandoah County: This event swept away homes, trailers, vehicles and washed away roads and bridges. There were 10 injuries and one fatality. Houses by Narrow Passage were flooded. Water covered roads near Mt. Jackson. US 11 between New Market and Mt Jackson was closed and US 33 near Elkton was blocked. In Strasburg, 20-30 boats and dock were lost, one home swept away and 6 partially flooded. Roads in southern end of the county suffered most damage. Schools were closed. The majority of losses were from crop damage, fences downed, topsoil destroyed, and farms destroyed. County damage estimate: \$2.6 million. Agricultural damages: \$274,000 in crop destruction and \$68,000 in livestock, fences, damaged farms.</p>

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Table C-3. Flood Hazard History

Date	Damages
November 9, 1985	<p><i>Cont.</i></p> <p>Warren County: This event caused damage to homes, farms, businesses, mobile homes, recreational camps, utilities and public property including highways and streets. County schools were closed. Two bridges, one at Bentonville and the other at Howellsville were underwater. 10 county roads and 55 other roads were closed. Residents were evacuated. 25 homes were swept away or moved from foundations. At North Fork, many travel trailers were damaged; one floated away. 10-12 mobile homes at Riverton washed away. There were nominal power and telephone outages. The local Red Cross helped 150 Warren County families and the Salvation army helped 8,000 people. County damage estimate: \$6.2 million.</p>
April 19, 1992	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley Herald and The Warren Sentinel)</i></p> <p>On April 21, a severe storm system entered Virginia producing flash flooding from heavy rains. In a 6 hour period 4.37 inches of rain fell in Clarke, more than 5 inches in southern Fort Valley, 2.5 to 4 inches in the Shenandoah Valley and 4.26 inches near Stanley to nearly 6 inches in Luray. The Shenandoah River crested at 17 feet in Warren County and at 16.3 feet at the White House monitoring station west of Luray.</p> <p>Clarke County: This event flooded basements, submerged cars, downed fences, and closed roads along the Shenandoah River. VA Routes 608, 621 and 638 were covered with water. Estimated damages for county: \$103,000.</p> <p>Page County: Page County suffered heavy property damage, one fatality and one injury. Most of the damages were at Dovel, Jollett and Weaver Hollows where bridges and roads were washed out. 25% of Dovel Hollow was without power. 13 residents were evacuated. Water flooded wastewater treatment plants in Stanley and Shenandoah. Basements along West Main in Luray were inundated. US 340 was briefly closed and the Hawksbill Creek covered the US 211 bridge near Luray and 200 yards of road. The George Washington National Forest had \$500,000 in damages. County estimated damages: \$200,000 with \$90,000 in private property and \$165,000 in county roadways.</p> <p>Warren County: Public and private roads had the most damage from the overflowing Shenandoah River. Flood waters closed various roads and roads leading into some of the largest river area subdivisions. A mudslide occurred on a secondary road. 60 residents of a subdivision were evacuated. School was closed 2 days. County estimated damages: \$315,000 with \$215,000 from road damages and \$100,000 from damages to homes and businesses.</p>

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Table C-3. Flood Hazard History

Date	Damages
January 27, 1996	<p><i>(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)</i></p> <p>On January 27th along with above freezing temperatures, 1.5 to 2 inches of rain fell in the region causing one of the worst flooding events in years. The Shenandoah River crested at 21 feet in Page County, 24.9 feet in Clarke County, 25 feet in Warren County, 27.83 feet in Shenandoah County</p> <p>Page County: This event produced the worst flooding in over 10 years. Melting snow and rainfall turned creeks into rivers. At one point Page County was under a high wind warning, flash flood warning, and winter weather advisory. 38 secondary roads were closed, closing all county schools. Flooded streets in Luray included Ninth Ave, Virginia Avenue, Third Street, Linden Avenue and First Street. Portions of US 340 were closed and the VA 677 bridge in Dry Run area of Luray was heavily damaged. Water from Hawksbill Creek overflowed into Mechanic Street. Raw sewage overflowed into several homes on Reservoir Avenue in Luray. Footbridges at Lake Arrowhead were washed out. Residents were evacuated in Weaver Hollow near the Page Rockingham County border. Sections of the Skyline Lakes dam were eroded</p> <p>Clarke County: Damage here was widespread. Many people outside of flood prone areas had water in their basements. One home was condemned and 58 homes were damaged, mostly with flooded basements. Recreation facilities in Watermelon Park were destroyed. Berryville's water filtration and sewage treatment plants were damaged. 21 roads in the county were submerged. Historic Burwell-Morgan mill in Millwood had \$10,000 in damages. County damage estimate: \$735,000 to homes, farming operations and businesses. Berryville estimated damages: \$70,000.</p> <p>Warren County: Melting snow plus rainfall carried debris, knocked down trees and electric poles, closed schools, and flooded homes and businesses. In Front Royal, a water line break drained 3 million gallons, flooding several roads, e.g. Commerce Ave. and Royal Ave. 200 Front Royal residents called about flooded basements and sewage backups. Flooding occurred along Happy Creek. Hardest-hit areas of the county were below where the North and South Forks of Shenandoah River converge. Subdivisions affected included Shenandoah Farms, Benny's Beach, Shenandoah River Estates, and Shenandoah Shores. 30-40 houses and structures were underwater. 7 families were evacuated. 125 Warren County residents applied for aid with FEMA.</p> <p>Shenandoah County: Rain and melting snow damaged roads and bridges, and washed out propane and fuel oil tanks from their places besides homes, in storage bins and in basements. Families were rescued from areas around Mill Creek, Stoney Creek, Edinburg and Mt. Jackson. Mt. Jackson had no drinking water. 110 county homes and Historic Edinburg Mill were severely damaged. Waters took 6 trailers from the Stoney Creek Campground in Edinburg. Large outbuildings and farm equipment were washed away. In Shenandoah County 122 roads and bridges were covered with water. Roads to Bayse were closed. Small bridge approaches were washed away and 5 swinging/footbridges were damaged. A Sinkhole occurred near Edinburg. Schools were out 8 days. 165 registered for help with FEMA. County agricultural damage was estimated at \$4.1 million from washed out roads, destroyed fences, crop loss, top soil removed, farm equipment damaged. Road damages were estimate at \$500,000 to \$3.4 million.</p>

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Table C-3. Flood Hazard History

Date	Damages
September 6, 1996	<p><i>(Source: The Clarke Courier, The Page News and Courier and The Shenandoah Valley Herald)</i></p> <p>On the evening of September 5th through September 6th, Hurricane Fran entered Virginia with heavy winds gusting at 30 mph, producing 10.28 inches of rain at Hogback Mt, 15 inches in Big Meadows on Skyline Drive, 4.5 inches in Luray, 8 inches in Browntown, 3.91 inches in Limeton and 7.12 inches in Strasburg. The Shenandoah River crested at 28 feet in Clarke County under Route 50, 26.82 in Millville, 38.26 feet in Strasburg, and 32.57 feet in Front Royal.</p> <p>Clarke County: Apples, fruit trees, corn, various vegetables, fences, farm lanes and roads were damaged. All roads along the Shenandoah River and its tributaries were closed. Damaged roads included Routes 7, 50, 603, 621, 622, 655, 660 and a sinkhole on Route 672. The Shenandoah River flooded Route 638, dividing the Shenandoah Farms subdivision in half. 300 residents lost power and several people were evacuated. 3 homes by White Horse Rock had heavy flood damage. According to FEMA, 39 primary homes and 12 secondary homes were damaged. Watermelon Park wiped out with \$100,000 in damages. County damage estimates: \$1.2 million in agricultural damage, \$894, 000 in property damage.</p> <p>Warren County: Red Cross estimated 250 homes were damaged as high winds and floodwaters tossed trees onto houses and cars, submerged homes, and carried debris down swollen creeks and the Shenandoah River. Power was out to 80% of county residents for a few days. Water service was disrupted. Areas of the county hardest hit were Browntown, Bentonville, South Warren, Shenandoah River Estates, Benny's Beach, Apple Mountain, Blue Mountain, and Shenandoah Shores. Half of the Gooney Creek Campground was covered in water. Between 40-50 people were in shelters or local motels. County damage estimate: \$46.1 million in property and agricultural damages.</p> <p>Page County: Agricultural losses to poultry, cattle and crop farmers were major. In Shenandoah National Park, 524 trees fell and 3,921 feet of road shoulder were damaged. Park damage was estimated at \$1 million. Almost every road in Page County was closed during this event. Virginia Routes 609, 624, 689, 654, 704, 759, and US 340 were damaged. Two low lying bridges in Luray and the VA 689 bridge over Hawksbill Creek were damaged. Thousands were without power and water. Electricity was out for the whole region except portions of Luray and Stanley. Water, telephone, and cable service was disrupted. Schools were closed and mail service was disrupted. Especially hard hit areas were Naked Creek and Crooked Run areas, and the Jollet, Weaver, and Steam Hollows. In Jollet Hollow, 20 homes were wiped out and emergency food was provided to 100 families in the 3 hollows. In Luray, an 8 inch water main that crosses the Hawksbill at the Main Street bridge washed out. This water main supplied one-half of the residents in Luray. Other damage included parking lots, the Main St bridge, sewer lines/manholes, and businesses along Main Street. Waters flooded Main Street</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-3. Flood Hazard History

Date	Damages
	<p>in Luray and ripped apart a barn. A house was moved by waters to the Luray High School football field. Areas in Luray with the most damage included Dry Run, Marye Lane, First Street, Hudson Subdivision, Furnace Road, and North Broad Street. 100 residents in Luray, 48 in Stanley, and 12 in Shenandoah sought shelter. Red Cross estimated 78 homes were destroyed, 117 had major damage, and 439 had damage of some kind. FEMA had 745 applications and estimated \$8.1 million in damages to Page County. Other damage estimates ranged from \$30 million to \$18.5 million. Agricultural damage estimates: \$2.6 million, includes damage to crop, livestock, buildings, and fences. Luray damages estimates: \$850,000 to town property. Stanley damage estimates: \$106,000 to water lines, roads and recreational facilities.</p> <p>Shenandoah County: Flooding closed roads and swept away six houses in Deer Rapids and Black Bear Crossing. Waters flooded basements and knocked down trees. All four footbridges across the Shenandoah River were destroyed. US Route 11 was blocked and the bridge at Burnshire Dam in Woodstock was submerged. Power was disrupted, especially at the southern end of the county. 165 homes, a park in Strasburg, numerous roads, and bridges were damaged by this event. The Strasburg water plant had \$150,000 of damages and required residents to boil their water. Telephone service was disrupted for 200 residents. 85 homeowners were helped by the Red Cross. In Mt. Jackson, 12 trailers were damaged and 23 residents were evacuated. Homes were moved from foundations in Columbia Furnace. FEMA funds were distributed to 28 families. Agricultural damages: \$7.2 million, with damages to corn, soybean and hay crops, fences, and livestock. Road damage estimate: \$1.4 million. County damage estimate: \$30 million.</p>

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Table C-4. Drought Hazard History

Date	Damages
September 1995	<p>Dry weather, combined with periods of excessive heat, caused some damage to several crops and limited the production of healthy livestock during a month-long period that extended through mid-September. The dry weather began after the soaking rains associated with the remains of Hurricane Erin (August 6) moved away. The drought conditions began in earnest over the following three weeks, as dry weather combined with a period of excessive heat (August 13 through 18) to wither crops. Across the region, monthly precipitation averaged one to two inches, with virtually all of it falling before August 7th. The drought continued into mid-September, when it was alleviated somewhat by steady rains late on the 16th and early on the 17th. However, mean temperatures were much lower in September, ironically due to drier air masses, which allowed temperatures to plummet into the 50s on several mornings.</p>
July 1997	<p>A very dry month, containing one 7 day heat wave, exacerbated drought-like conditions across much of the fertile farmland of northern Virginia. The weather in July proved to be the death knell for much of the crop yields, including corn, hay, alfalfa, and soybeans. Clarke Co (VAZ031) alone reported \$2 million in crop damage. Other counties in the northern Virginia piedmont reported damage via local farms; dollar estimates were similar to those in Clarke Co, though no formal declarations of federal emergency were received from them.</p>

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Table C-4. Drought Hazard History

Date	Damages
August 1998 - December 1998	<p>Persistent high pressure brought unusually dry weather during the entire month for much of northern and central Virginia. The lack of rainfall substantially reduced crop yields and contributed to increasingly dry timber and brush. The U.S. Forest Service reported the George Washington and Jefferson National Forests were twice as dry as normal, and five fires broke out in these parks during the first week of the month. One of these fires burned a small portion of land near Schothorn Gap in Page Co. In addition to the fire threat, reservoirs continued to dry out. Other monthly rainfall totals from affected counties included 1.5 inches in Page, 0.7 in Warren, and 0.4 in Shenandoah, Winchester reported only 0.3 inches during November. Warren County asked to be declared an agricultural disaster area during November, citing 107 farmers with 60-69% fall production losses and 100 farmers with losses between 40-60%. The hardest hit fall crops were barley, corn, hay, soybeans, tobacco, and wheat. Over 2,000 acres burned in the George Washington and Thomas Jefferson National Forests in Augusta County. December monthly precipitation totals from counties included 0.8 inches in Frederick, 1.2 inches in Clarke, 1.4 inches in Orange and Warren, 1.5 inches in Shenandoah. The Governor declared a state of emergency across Virginia on December 1st due to the dry weather and resulting extreme fire danger. An open burning ban continued across Virginia through December 10th.</p>
May 1999 - September 1999	<p>High pressure was the dominant weather feature across Northern Virginia during the month. This weather pattern directed rain producing low pressure systems north of the region and continued the climatological drought that has gripped the area since last summer. By the last week of May the Palmer Drought Index, a measure of long term drought conditions, indicated Northern Virginia was in a moderate drought. Rainfall totals included Frederick County at 1.5 inches, Shenandoah County at 2.9 inches, and Warren County at 1.4 inches. Conditions on the Shenandoah and Rappahannock River were also extremely dry. Some stations in these two watersheds reported stream flow at or below the 90th percentile exceedence, which rivaled minimum daily mean flow values of the drought of 1980 through 1982. Some farmers had to reduce their herd sizes in order to stretch hay and water supplies. In addition to agricultural lands, forests and rural vegetation was also dangerously dry. In Page County alone, fifteen brush fires were reported in May near Stanley, including one that burned 100 acres. Another fire in Shenandoah National Park burned around 400 acres and closed a 40 mile stretch of Skyline Drive for several days during the first week of the month. Rainfall from two land falling hurricanes made a tremendous impact on the drought that plagued the region since the summer of 1998. Rainfall</p>

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Table C-4. Drought Hazard History

Date	Damages
	totals included Clarke County at 13.0 inches, Page County at 12.8 inches, Warren County at 12.5 inches, and Shenandoah County at 9.1 inches. In Shenandoah County, 30 ponds that went dry during the past 12 months were rejuvenated by the 8th. The South Fork of the Shenandoah River in Front Royal finally rose to a sufficient level to allow water to rush over the dam, following a several month absence.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
July 15, 1951	<p><i>(Source: Shenandoah Herald, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)</i></p> <p>Sunday evening July 15th a severe storm with high winds, hail and thunder entered the region and swept over parts of Warren, Shenandoah and Frederick Counties producing 5 inches of rain in the Town of Timberville and 2 inches in the Town of Woodstock.</p> <p>This event damaged southern and western parts of Woodstock and produced the worst flooding in years. Basements and cellars were flooded. Businesses had water damage and a barn was destroyed by fire from lightning. Trees fell and there was damage to orchards and crops. The Virginia Electric and Power Company had 10 inches of water. In Timberville, the rain washed fields, gardens and roads. In Forestville, high waters covered bridges and roads and washed away flood gates, gardens, cut wheat and trees. In the White Hall section near Winchester this event ripped roofs from buildings, twisted houses on their foundations, knocked down telephone lines and virtually destroyed farm crops in a two-mile area. Lighting caused building fires in Front Royal.</p> <p>This event affected the following towns: White Hall, Timberville, Front Royal, Forestville, Quicksburg, Conicsville and the Fort Valley section of Shenandoah east of Strasburg.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
October 15, 1954	<p><i>(Source: The Clarke Courier, Page News and Courier, Shenandoah Valley, The Warren Sentinel and the Winchester Evening Star)</i></p> <p>On October 15th Hurricane Hazel entered the region producing strong winds with gusts up to 40 mph and 9 inches of rain at Shenandoah National Park, 11.20 inches at Big Meadows and 4.05 inches in Winchester. High waters made roads impassible for a time.</p> <p>Winchester City: 10-50% of the apple crops in Winchester were damaged.</p> <p>Clarke County: The Shenandoah River rose over the 6 ft marker at Bixler's Ferry Bridge, 12 to 15 feet higher than normal by Berryville. In Berryville, water flooded Main and Church Streets Approximately 15% of the apple crop reported damaged. Livestock (poultry) was also reported as a loss.</p> <p>Shenandoah County: Damage to apple orchards and livestock was reported.</p> <p>Frederick County: Approximately 15% of the apple crop reported damaged. Also reported was livestock loss, mostly poultry.</p> <p>Page County: minor and some major damage were reported. This storm caused several creeks (i.e., Hawksbill and Dry Run) to overflow, uprooting trees, knocking over fences, scouring roads and washing out parts of bridges. The Luray Sewage Treatment Plant had \$1,000 in damages from the overflowing Hawksbill Creek, which also covered US 340 north and south of Luray and carried debris. Many county roads were impassible from high waters and submerged cars. Fallen trees damaged power wires. Stanardsville had major wind damage, with fences, chimneys, antennas, and trees down with debris along the highways.</p> <p>Warren County: this storm event produced losses in livestock, mostly poultry.</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
August 12, 1955	<p><i>(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)</i></p> <p>From Thursday evening, August 11th to Saturday, August 13th, Hurricane Connie entered Virginia producing minor winds up to 30 mph and rains of 4.71 inches in Clarke County, 3.57 inches at Shenandoah National Park, 6.37 inches at Big Meadows and 6.42 inches in Winchester. The Shenandoah River rose 6 feet above its normal level.</p> <p>Clarke County: Damage from this event was fairly light. Corn, apples, peaches and trees were knocked down. Power and telephone service was disrupted. Electricity to Berryville was out for several hours. Fields, secondary roads and roads along the Shenandoah River were flooded.</p> <p>Page County: Some mountain streams reached flood stage. Rocky Branch washed out sections of roadway. Trees, crops, power lines and antennas were knocked down. There was some livestock loss.</p> <p>Winchester City: This event knocked down trees, blocking roads and causing some power and telephone outages. There was minor crop damage. Two injured and an automobile overturned.</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
August 19, 1955	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Winchester Evening Star and The Warren Sentinel)</i></p> <p>On Wednesday evening, Hurricane Diane entered Virginia producing minor winds up to 40 mph and 2.98 inches of rain in Clarke County, 10.33 inches at the Shenandoah National Park and 11.48 inches at Big Meadows on the Skyline Drive. The Shenandoah River crested at 29 feet in Clarke County, 29 feet at the Northern & Western Bridge in Warren County, 17 feet by Luray, and 19.9 feet by Berry's Ferry on Route 50.</p> <p>Winchester City: Winchester was cut off to west and south as main highways were underwater.</p> <p>Frederick County: Basements in Middletown were flooded. US Route 11, Route 12, Route 522, and Route 50 were closed.</p> <p>Shenandoah County: The Naked Creek caused significant damage to Verbena. One person drowned in the Shenandoah River near Strasburg. In Woodstock, a break in waterlines compromised the water system. Serious basement flooding occurred at Woodland, Opequon and Berryville Avenue in Woodstock.</p> <p>Clarke County: Since the ground was saturated from Hurricane Connie, waters flooded low lying pastures, fields and river roads. Fences were torn down and crops of corn, beans, tomatoes, and watermelons were ruined. Watermelon Park was damaged, several cabins were damaged but, with one exception, no houses were flooded. Telephone service was disrupted and the receding river left much debris. Damage was estimated in the thousands of dollars.</p> <p>Warren County: This event flooded some roads, produced minor crop damage and minor power outages. Main damage was from sewage overflow into basements. Hard hit were the Front Royal Country Club and the Guilford Electrical Contractors property near Passage Creek. Several homes were flooded in Front Royal and Riverton areas.</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
August 19, 1955	<p><i>Cont.</i></p> <p>Page County: 25 residents left their homes along the Hawksbill Creek. Property, livestock and highways had damage. Secondary highways were hard hit. Damaged areas cited included Shenk and Beahm Hollows by Rocky Branch, east of Luray in the Dry Run watershed and in the Ida section. Highway damage was estimated at \$50,000, not including replacing the Naked Creek bridge. Livestock damage was estimated at \$100,000. County damage estimate: \$150,000.</p>
May 23, 1959	<p><i>(Source: The Clarke Courier and The Winchester Evening Star)</i></p> <p>On Saturday afternoon, May 23rd, a severe storm system entered the region producing minor rain but strong winds. This event was the second storm within a week and produced 2-3 inches of rain in northern Frederick County and 0.21 inches in Clarke County. This storm came from the northwest and swept into Clarke County, passing between Winchester and Martinsburg, WV with the worst in Stephenson, VA.</p> <p>Clarke County: This event blew off the roofs of both a house and a barn and caused damages to public utilities, trees, chimneys, and antennas. Telephone service for 200 residents was disrupted and a traffic light was out.</p> <p>Frederick County: Power and telephone services were interrupted. Lightning struck a barn at Longwood, north of Millwood. Hail smashed windows, damaged orchards and knocked down trees. Roads flooded included Route 671, Route 11, and Route 664. Noted areas of damage: White Hall, Stephenson and Burnt Factory.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
October 1, 1959	<p><i>(Source: The Clarke Courier, Winchester Evening Star and Warren Sentinel)</i></p> <p>On October 1, a downgraded Hurricane Gracie entered the region producing 2.03 inches of rain in Clarke County, 2.29 inches in Winchester, 2.05 in Berryville and 0.56 inches in Warren County.</p> <p>Winchester City: This storm event produced no serious damage, however roads were temporary covered. There were minor power outages and 200 telephone lines were knocked out. No other information was provided on this event.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 23, 1972	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)</i></p> <p>On June 20th through June 22nd, Hurricane Agnes entered Virginia producing 6.07 inches of rain in Clarke County, 8.15 inches at the Shenandoah National Park, 13.35 inches at Big Meadows atop the Blue Ridge, 6.55 inches in Front Royal, and 8.09 inches in Winchester.</p> <p>Clarke County: Hurricane Agnes flooded lowlands, including summer retreats at Shenandoah Farms and The Shenandoah Retreat. 50 families from Shenandoah Farms were evacuated. At this location 13 structures were destroyed. Areas with damages included White Haven, Bradfield Subdivision, Riverside Rendezvous and Watermelon Park. Many cellars were flooded. 11 roads were closed. Two were trapped on an island in Passage Creek. The receding river left much silt and debris. Losses in the county were estimated to be in the thousands of dollars. The Shenandoah River crested at 21.5 feet.</p> <p>Page County: This hurricane produced the worse flood in 30 years causing heavy damages to buildings, fences, roads, bridges, culverts, farmlands and crops near the Shenandoah River, the Hawksbill Creek and in low-lying areas. More than 30% of crops were damaged. Several permanent homes, vacation homes, trailers and poultry houses were damaged. Campgrounds and summer homes along the Shenandoah River were nearly covered. Residents along the Shenandoah River, Hawksbill Creek and other streams were evacuated in addition to residents of the Brookside Subdivision in East Luray. More severe damage was done to small bridges, roads, and culverts in part of the county. The Hawksbill Creek severely damaged the Linden Avenue and Dyche Bridges in Luray and carried a truck downstream. Roads in Luray and Shenk Hollow were washed out. Shenandoah's water treatment plant was out of service. Most heavily damaged section was the Pine Grove area near Stanley. There was one fatality. Luray damage estimate: \$25,000. County damage estimate: \$100,000, in farm and crop damage.</p> <p>Frederick County: Many roads leading to the Shenandoah River and across Cedar and Opequon Creeks were closed. Low lying roads along Back Creek, Hogue Creek, Isaac Creek, and Cedar Creek were underwater. 200 emergency calls were reported.</p>

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 23, 1972	<p><i>Cont.</i></p> <p>Shenandoah County: This event flooded low farm lands and blocked major and secondary roads. There was some agricultural and livestock damages. Over 78 highway locations had damage from stream crossings and with debris and mudslides at several locations. Ditches were washed out and debris/silt/stone was deposited on roads. There was a large mudslide in the Zepp area of western Shenandoah County. Cedar Creek damaged a wayside and spread debris over several roads. Meem's Bottom road, Redbanks Bridge and U.S. 11 were covered. County damage estimate: \$106,000 with damage mostly on secondary roads.</p> <p>Warren County: Areas adjacent to either fork of the Shenandoah River were underwater for days. Happy Creek, South Fork, and Passage Creek overflowed. Riverton was flooded. This event completely destroyed 21 homes, seriously damaged 150 homes, and left 50 homes with minor damage. 14 homes in Shenandoah Farms, 4-5 homes in Mandalay, 2 homes in Shenandoah Shores, 2 homes and 5 trailers at Avalon Shores in Riverton were lost to flooding. Bridges at Bentonville and Morgan's Ford were underwater. Telephone service was out. The biggest problem was backed up sewage. People got typhoid shots. There was no drinking water. County damage estimate: \$1.5 million. The Shenandoah River rose 29.56 feet in Warren County,</p> <p>Winchester City: The Abrams Creek overflowed its banks stranding cars and flooding homes and trailer parks. 3 businesses were damaged from runoff. 200 homes were pumped. Sanitary sewers were overloaded causing backups in basements. Problem areas included Paper Mill Road, Acorn Heights, Whittier Avenue and Amherst Street.</p>
November 9, 1985	<p><i>(Source: The Clarke Courier, The Page News and Courier, The Warren Sentinel and The Shenandoah Valley-Herald)</i></p> <p>From Thursday, October 31st through Monday, November 4th, Hurricane Juan entered Virginia producing 5 inches in Strasburg and 6.23 in Front Royal. The Shenandoah River crested at 34.4 feet in Clarke County, 35.4 feet near Front Royal, 34.4 ft on the South Fork, 27 feet on the North Fork and 40 feet at Riverton. For this event there were two crests, one that flooded Luray and another that flooded Shenandoah County.</p> <p>Clarke County: 40 homes and weekend cabins were damaged. Buildings between Routes 7 and 50 and at Shenandoah Farms</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
	<p>were ruined. Recreational facilities at Watermelon Park and River Park were washed away. There was significant damage on Routes 603 and 621. Over 1,000 residents had power outages. The water system was contaminated. Farmers in low lying areas lost crops, fences, livestock and farm equipment estimated at \$121,000. County damages estimate: \$850,000.</p> <p>Page County: This event rivaled the flood of 1870. Several homes, dozens of trailers, and automobiles were damaged along the Shenandoah River's South Fork, Naked Creek, Hawksbill Creek, and other areas. Naked Creek was out of it banks onto the highway. Flooding occurred in Luray, Stanley, Shenandoah, and surrounding areas. The VA Route 611 bridge over Hawksbill Creek fell into river and the VA Route 626 bridge was damaged. North of Luray residents were evacuated by helicopter. 40 miles of fences were destroyed or damaged. Crops were damaged. Power and telephone outages occurred throughout the county. In Luray, some residents were without water. 140 Page County residents registered for flood relief. County damage estimate: \$2.4 million, with \$1.8 million in private property damage and \$540,000 in public property. Damages of state routes in the county: \$445,000-\$500,000.</p> <p>Warren County: This event caused damage to homes, farms, businesses, mobile homes, recreational camps, utilities and public property including highways and streets. County schools were closed. Two bridges, one at Bentonville and the other at Howellsville were underwater. 10 county roads and 55 other roads were closed. Residents were evacuated. 25 homes were swept away or moved from foundations. At North Fork, many travel trailers were damaged; one floated away. 10-12 mobile homes at Riverton washed away. There were nominal power and telephone outages. The local Red Cross helped 150 Warren County families and the Salvation army helped 8,000 people. County damage estimate: \$6.2 million.</p> <p>Shenandoah County: This event swept away homes, trailers, vehicles and washed away roads and bridges. There were 10 injuries and one fatality. Houses by Narrow Passage were flooded. Water covered roads near Mt. Jackson. US 11 between New Market and Mt Jackson was closed and US 33 near Elkton was blocked. In Strasburg, 20-30 boats and dock were lost, one home swept away and 6 partially flooded. Roads in southern end of the county suffered most damage. Schools were closed. The majority of losses were from crop damage, fences downed, topsoil destroyed, and farms destroyed. County damage estimate: \$2.6 million. Agricultural damages: \$274,000 in crop destruction and \$68,000 in livestock, fences, damaged farms.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
April 4, 1995	In Winchester City, high sustained winds estimated at 40 mph with gusts to 50 mph blew a large tree onto the roofs of two homes, causing minor structural damage to them. A gas meter at one of the homes was damaged, starting a small leak. The high winds, however, reduced the concentration of gas in any one area, and no explosions occurred.
June 10, 1995	In Winchester City, a construction trailer was damaged by thunderstorm winds. Several maple trees were blown down, and eight to 10 telephone poles were found leaning in one direction due to the high winds. Panels were blown off a greenhouse along state route 37 near federal Highway 11. Fallen branches broke several automobile's windshields. Trees were also reported to be blocking local Routes 634 and 642, and the on-ramp to Interstate Highway 81.
July 6, 1995	In Page County, widespread tree damage in the central and northern portions of the county. A metal shed was crushed and blown into the road. A barn north of Luray was destroyed by winds killing two cattle and heavily damaging farm vehicles and equipment. Property damage at the farm was estimated to be around \$200 thousand.
October 5, 1995	Sustained winds of 40 mph, with gusts in excess of 60 mph, blew down several trees at higher elevations (mainly above 2,000 feet) in the Shenandoah Valley and along the Allegheny Plateau. The winds were associated with the remains of Hurricane Opal, which was accelerating through the lower Ohio Valley during the afternoon of the 5th. In the southern portion of the City of Winchester, an estimated 2,000 customers were without power after a feeder lockout (7200 Volt) was knocked out. The National Park Service reported dozens of trees blown down along Skyline Drive in Page and Warren Counties..
May 4, 1996	A microburst produced wind gusts estimated at 70 mph, which blew down numerous tents at a Boy Scout "camporee" in the New Market Battlefield Park, Shenandoah County. Fortunately, there were no injuries among the 1500 scouts attending the event.
July 14, 1996	A microburst destroyed a 1,300 square-foot barn at a farm. A nearby 800 pound loader was moved 15 to 20 feet by the winds, but was not damaged.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
September 6, 1996	<p><i>(Source: The Clarke Courier, The Page News and Courier and The Shenandoah Valley Herald)</i></p> <p>On the evening of September 5th through September 6th, Hurricane Fran entered Virginia with heavy winds gusting at 30 mph, producing 10.28 inches of rain at Hogback Mt, 15 inches in Big Meadows on Skyline Drive, 4.5 inches in Luray, 8 inches in Browntown, 3.91 inches in Limeton and 7.12 inches in Strasburg. The Shenandoah River crested at 28 feet in Clarke County under Route 50, 26.82 in Millville, 38.26 feet in Strasburg, and 32.57 feet in Front Royal. Gusty winds in excess of 40 mph, combined with soft soil from previous rainfall, caused scattered tree damage across much of the Virginia Piedmont and a small area of the coastal plain. At elevations above 2,000 feet, sustained tropical-storm force winds with gusts as high as 79 mph pummelled the landscape, especially the east-facing slopes of Shenandoah National Forest and the George Washington National Forest. Thousands of mainly light wood trees (pines and maples) were snapped or uprooted. Along Skyline Drive alone, over 500 trees had to be cleared from the roadway before it could be reopened. Numerous trails had trees down; some trails remained closed more than one month after the event. In the central Shenandoah Valley, an area closest to the storm track, widespread scattered tree damage was noted.</p> <p>Clarke County: Apples, fruit trees, corn, various vegetables, fences, farm lanes and roads were damaged. All roads along the Shenandoah River and its tributaries were closed. Damaged roads included Routes 7, 50, 603, 621, 622, 655, 660 and a sinkhole on Route 672. The Shenandoah River flooded Route 638, dividing the Shenandoah Farms subdivision in half. 300 residents lost power and several people were evacuated. 3 homes by White Horse Rock had heavy flood damage. According to FEMA, 39 primary homes and 12 secondary homes were damaged. Watermelon Park wiped out with \$100,000 in damages. County damage estimates: \$1.2 million in agricultural damage, \$894, 000 in property damage.</p> <p>Page County: Agricultural losses to poultry, cattle and crop farmers were major. In Shenandoah National Park, 524 trees fell and 3,921 feet of road shoulder were damaged. Park damage was estimated at \$1 million. Almost every road in Page County was closed during this event. Virginia Routes 609, 624, 689, 654, 704, 759, and US 340 were damaged. Two low lying bridges in Luray and the VA 689 bridge over Hawksbill Creek were damaged. Thousands were without power and water. Electricity was out for the whole region except portions of Luray and Stanley. Water, telephone, and cable service was disrupted. Schools were closed and mail service was disrupted. Especially hard hit areas were Naked Creek and Crooked Run areas, and the Jollet, Weaver, and</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
	<p>Steam Hollows. In Jollet Hollow, 20 homes were wiped out and emergency food was provided to 100 families in the 3 hollows. In Luray, an 8 inch water main that crosses the Hawksbill at the Main Street bridge washed out. This water main supplied one-half of the residents in Luray. Other damage included parking lots, the Main St bridge, sewer lines/manholes, and businesses along Main Street. Waters flooded Main Street in Luray and ripped apart a barn. A house was moved by waters to the Luray High School football field. Areas in Luray with the most damage included Dry Run, Marye Lane, First Street, Hudson Subdivision, Furnace Road, and North Broad Street. 100 residents in Luray, 48 in Stanley, and 12 in Shenandoah sought shelter. Red Cross estimated 78 homes were destroyed, 117 had major damage, and 439 had damage of some kind. FEMA had 745 applications and estimated \$8.1 million in damages to Page County. Other damage estimates ranged from \$30 million to \$18.5 million. Agricultural damage estimates: \$2.6 million, includes damage to crop, livestock, buildings, and fences. Luray damages estimates: \$850,000 to town property. Stanley damage estimates: \$106,000 to water lines, roads and recreational facilities.</p> <p>Shenandoah County: Flooding closed roads and swept away six houses in Deer Rapids and Black Bear Crossing. Waters flooded basements and knocked down trees. All four footbridges across the Shenandoah River were destroyed. US Route 11 was blocked and the bridge at Burnshire Dam in Woodstock was submerged. Power was disrupted, especially at the southern end of the county. 165 homes, a park in Strasburg, numerous roads, and bridges were damaged by this event. The Strasburg water plant had \$150,000 of damages and required residents to boil their water. Telephone service was disrupted for 200 residents. 85 homeowners were helped by the Red Cross. In Mt. Jackson, 12 trailers were damaged and 23 residents were evacuated. Homes were moved from foundations in Columbia Furnace. FEMA funds were distributed to 28 families. Agricultural damages: \$7.2 million, with damages to corn, soybean and hay crops, fences, and livestock. Road damage estimate: \$1.4 million. County damage estimate: \$30 million.</p> <p>Warren County: Red Cross estimated 250 homes were damaged as high winds and floodwaters tossed trees onto houses and cars, submerged homes, and carried debris down swollen creeks and the Shenandoah River. Power was out to 80% of county residents for a few days. Water service was disrupted. Areas of the county hardest hit were Browntown, Bentonville, South Warren, Shenandoah River Estates, Benny's Beach, Apple Mountain, Blue Mountain, and Shenandoah Shores. Half of the Gooney Creek Campground was covered in water. Between 40-50 people were in shelters or local motels. County damage estimate: \$46.1 million in property and agricultural damages</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 18, 1997	<p>A rapidly developing heavy-precipitation supercell produced several instances of severe weather over portions of the northern Shenandoah Valley and Piedmont regions of Virginia during the late afternoon and evening of the 18th. Four small tornadoes were confirmed: one in northern Shenandoah County near the town of Wheatfield, one in extreme southeast Frederick Co in the community of Double Tollgate, a third in Clarke Co near the town of Berryville, and a fourth in Loudoun Co between Mountville and Oatlands. Damage in Wheatfield was confined to a heavily wooded rural area, where 20 trees were snapped or uprooted along a narrow but distinctive path. Winds were estimated to be around 80 mph. It was the first tornado ever reported in the county; perhaps partially due to a NWS survey team locating the damage. The twister lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating. The second small tornado touched down east of Klines Corner in southeast Frederick Co. Five trees were downed on one farm, and damage was spotty along a 3-mile path to Double Church Road just southwest of Double Tollgate. A spotter had previously reported a touchdown near this area. Most of the damage was to trees, though some minor roof and fence damage was observed along and near Double Church Road. In Clarke Co, a third tornado touched down just south of Berryville. Minor damage was noted to a roof and shingles at a house; an electric garage door was damaged as well. A circular pattern was noted in the tall grass and in branches that had broken off nearby trees.</p>
June 26, 1997	<p>A pre-frontal squall line moving into very unstable air produced several instances of straight-line wind damage, including some from in-storm downbursts and others along the gust front. The most intense damage occurred early in the event, in northeast Frederick Co. A strong downburst, containing estimated winds of 80 to 100 mph, produced a swath of damage approximately 1 mile wide and 4 miles long between Welltown and Stephenson. The heaviest structural damage occurred with the onset of the downburst at an industrial park located just north of the intersection of interstate 81, federal highway 11 and state route 37. Damage at the park included one steel-frame building (under construction) which collapsed, and minor damage to several other buildings. The downburst raced into nearby forested areas, where heavy damage was sustained (numerous trees were uprooted or snapped) and some utility poles were felled. Thereafter, four residential homes sustained roof damage, with two declared uninhabitable. One large barn collapsed, as did three large sheds. Two mobile homes shifted off their moorings. A total of 50 structures sustained minor to major damage, including siding, gutters, windows, and roofs. Additional tree damage, including one onto a car, occurred in nearby Stephenson before the downburst dissipated. Other tree damage was reported in Madison and Clarke Cos. Several trees fell in northern Clarke Co along local route 611.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
July 28, 1997	A squall line, which originated from an individual thunderstorm in southwest Pennsylvania, produced scattered wind damage across northern Virginia during the late afternoon as it raced across the region. The most impacting damage occurred in Frederick Co, where numerous trees and wires were blown down in the Winchester area. One of those trees became an airborne missile, crashing through an automobile windshield and slightly injuring the 30-year old female driver. In Clarke Co, several trees and large limbs were felled in the Berryville area, including one onto the historic home of George Washington's adopted daughter. Numerous wires were reported down as well.
June 13, 1998	A vigorous upper-level disturbance acted upon increasingly warm and humid air near the surface to produce a squall line of strong to severe thunderstorms which traversed all of northern Virginia during the afternoon. Overall, damage was dominated by numerous downed trees, large limbs, and power lines, though there were scattered occurrences of large hail with the more intense cells. Localized small stream and poor drainage flooding was noted, but true flash flooding did not occur due to the rapid movement of the line. Initial damage occurred across northwestern Virginia, where there were several instances of scattered trees and large limbs down across portions of Clarke, Loudoun, Warren, and Fauquier Cos. There were several citizen and police reports of funnel clouds in the area, but surveys determined that damage was straight-line in nature - either due to embedded microbursts or the gust front. Farther south, hail fell, most between three-quarters and one inch in diameter.
June 15, 1998	The juxtaposition of a northward moving warm front, strong surface low pressure over the midwest, and a fast upper-level jet combined to produce another outbreak of severe weather - this coming two days after a notable episode over much of northern Virginia on the 13th. Once again, damage was highlighted by downed trees, large hail, and several cases of flash flooding. Several side streets were flooded, not only in Woodstock but in nearby Toms Brook as well. As the storms tracked east, there were several reports of hail ranging from 0.75" to 1" in diameter. Additional flash flooding occurred in Warren Co, where a minor mud slide temporarily closed a portion of Browntown Road. Low-lying flooding closed the intersection of River and Harrell Road. Around this time, one thunderstorm cell became dominant as it crossed into Fauquier Co. Soon after, the storm exhibited a bow-echo feature, and accounts of damaging winds increased accordingly.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
July 30, 1998	An isolated rotating thunderstorm developed along a stationary front over western Frederick Co and moved east, producing some wind damage and a small tornado near and east of Gainesboro. At a residence on Hunting Ridge Road just east of Gainesboro, a brief tornado snapped or uprooted 50 to 60 trees, including pines and oaks. One of the trees smashed a portion of a fence. Moments earlier, in Gainesboro, lightning started two grass fires and struck a home, causing minor damage. Strong winds blew down several power lines as well.
March 3, 1999	Trees and power lines downed A low pressure system moved from West Virginia to Pennsylvania on the evening of the 3rd. This system produced sustained winds of 25 to 40 mph from the afternoon of the 3rd through the morning of the 4th. A cold front associated with the system moved through during the early evening and produced a line of thunderstorms that brought heavy rain, small hail, and wind gusts in excess of 55 mph. In Shenandoah County, downed trees and power lines were reported across the county. 1,375 customers reported power outages. A roof was blown off an outbuilding in Fairview near Woodstock, and the top of an automated teller machine at the Strasburg Shopping Center was also blown off. Frederick County reported substantial damage to a large wall at the Rubbermaid Commercial Products Receiving Warehouse in Winchester. The wind also leveled several trees and signs. 6,000 customers reported power outages. The peak gust at the Winchester Airport was 42 mph. Most locations received an inch or less of snow overnight, however Frederick County received 2 to 5 inches and a location on the Clark and Loudoun County line received 3 inches.
April 23, 1999	A line of thunderstorms developed in West Virginia during the early afternoon and moved rapidly southeast across Northern Virginia. These storms produced very large hail in a 10 mile wide strip from Winchester in Frederick County to Woodbridge in Prince William County. Winds over 55 MPH also downed trees and power lines in Frederick and Clarke County. Frederick County spotters reported between 1 3/4 to 3 1/2 inch diameter hail. The rubber membrane roof of the War Memorial Building in Winchester was punctured by hail the size of golf balls, allowing heavy rain to fall inside the structure and cause significant water damage. Numerous cars were damaged by hail, averaging \$1300 in repairs. Winchester city police reported damage to 15 cruisers, and automobile dealers on Valley Avenue reported damage to over 150 cars. Hundreds of other privately owned vehicles received dents and broken windshields. Property owners also reported damage to roofs, siding, windows, and landscaping from the 10 minute deluge. Northwest of Winchester, strong winds left behind a narrow path of uprooted or snapped trees and minor trim damage to a home. Clarke County was the next location in the path of the storm. Hail of up to 1 3/4 inch in diameter tore leaves from trees, damaged siding and shingles on homes, and dented automobiles. Strong winds also snapped or uprooted between

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
	Beacon and the Shenandoah River.
May 12, 1999	One tree uprooted and several trees split in a county park A thunderstorm producing wind over 55 MPH moved across Northern Clarke County. County park officials reported the storm downed a large tree by the recreation office and split several other trees lining the entrance driveway. Also, a staff member who was driving a maintenance truck around the county park during the storm reported gusty winds caused their vehicle to shake.
July 31, 1999	Scattered thunderstorms developed over the Shenandoah Valley. One storm moved across Clarke County and produced winds in excess of 55 MPH, downing trees in White Post. Two trees blocked Route 644. Lightning from another thunderstorm ignited a forest fire west of Woodstock in Shenandoah County on the 31st.
August 13, 1999	An area of thunderstorms that developed across West Virginia moved across Northern Virginia on the 13th through the 14th. The strongest storms produced wind gusts in excess of 55 MPH, frequent lightning, and heavy downpours. Downed trees were reported across Shenandoah County. Trees were also downed just east of Strasburg in Warren County.
August 14, 1999	Trees downed An area of intense thunderstorms producing damaging winds, frequent lightning, and heavy downpours moved across extreme Northern Virginia between 3:00 PM and 6:00 PM EDT. As the storms moved across Clarke County, straight line winds in excess of 55 MPH demolished a shed on a farm near White Post. The shed's heavy roof was lifted off and set down 50 feet away from the rest of the structure. A tree nearby was also toppled. County officials reported several other trees down across the county, including some across Route 50. In Warren County, strong winds downed several trees in Front Royal around 3:15 PM EDT. As the storms crossed Fauquier County, a wind gust of 60 MPH was measured in Warrenton.
September 7, 1999	Only a few days after Northern Virginia received rains from the remnants of Hurricane Dennis, an area of thunderstorms moved through the area producing damaging winds, large hail, frequent lightning, and very heavy downpours. The storms affected the region. Frederick and Clarke Counties received the heaviest rainfall, and suffered from Significant flash flooding. An observer in Clearbrook reported rain gauges that held 5 inches overflowed during the storm. Another observer in the eastern half of Frederick County received a total of 5.3 inches, with 3.5 inches of the total recorded in 1 hour. One location in Clarke County reported 3.8 inches of rain in 1 hour. A portion of Highway 7 was closed by high water near Berryville. Both Boyce and Berryville reported street flooding. The communities of Greenwood and Stephens City reported several flooded roads and basements. Severe flooding and mudslides blocked roads between Highway 7 and Route 50, and another mudslide affected Route 50. In addition, Route 635, 657, 255, 621, 620, 651, and 761 were all closed for a short period of time due to high water in Clarke

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
	County. Shenandoah County also received heavy rain and reported minor flooding. Just south of Strasburg, 1.5 inches fell. County officials reported a low lying bridge on Highway 744 was covered with water in the Deer Rapids area near Massanutten Mountain. A low water bridge at Black Bear Crossing east of Maurertown and at Chapman's Landing south of Woodstock were also flooded and impassable. Several basements and roads were flooded in Strasburg. In addition, winds in excess of 55 MPH downed trees and power lines in several locations. Several trees were downed in the eastern part of Frederick County. Power lines were downed and lightning started several tree fires in the Greenwood area. Trees were downed across Clarke County with a concentration in the Berryville area. .
September 16, 1999	Hurricane Floyd made landfall just east of Cape Fear, North Carolina in the early morning hours of the 16th and moved north-northeast across extreme southeast Virginia to near Ocean City, Maryland by evening on the 16th. Rain bands on the outer edge of the hurricane began to affect northern Virginia on the 15th and continued to cross the area through afternoon on the 16th. The eye of Hurricane Floyd passed east of the Chesapeake Bay on the 16th. Gusty winds of 30 to 50 MPH blew north and east of a line from Spotsylvania County to Frederick County on the 16th. Hundreds of trees were downed from the combination of very heavy rain and strong winds. A total of 2 to 5 inches of rain fell in this area and 16,000 power outages were reported. In Winchester, a home was damaged by a fallen tree and a few customers lost power.
September 29, 1999	An area of intense showers moved across Northern Virginia on the 29th through the 30th, producing winds in excess of 55 MPH and very heavy downpours. Flash flooding was reported in several counties, and high winds knocked numerous trees and power lines down. In Frederick County, winds gusted to 60 MPH at Hayfield. An old convenience store along Route 50 in the Hayfield area had sections of its roof ripped off and thrown into the parking lot. Trees and power lines were downed across the northern half of the county and the city of Winchester, resulting in power outages for 1400 customers. Fallen trees blocked 1 1/2 lanes of Interstate 81 southbound between Route 50 and Route 7. High winds blew a metal canopy off a building along Route 50 east of Winchester and brought trees down across the highway. Winds gusted to 47 MPH at the Winchester Airport. Clarke County reported wind damage and flooding. Trees and power lines were downed countywide blocking 25 roads, including Route 540, 955, and 1513. An acre of trees on Blue Ridge Mountain was flattened. Flash flood waters washed out a culvert on Route 723 and a bridge on Route 604.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
January 13, 2000	A vigorous cold front moved across Northern Virginia from west to east midday on the 13th. Winds in excess of 55 MPH reached the surface after the front moved through. Fire fighters across the region were kept very busy by several brush fires that were started by downed power lines and spread quickly because of the gusty winds. In Frederick County, trees and power lines were downed in Stephens City and downed trees blocked Middle Road, Stoney Hill Road, and Morgan's Hill Road. A carport was blown off a home in Berryville. In Winchester, a house lost a portion of its roof and a wind gust of 52 MPH was recorded. In Clarke County, downed trees and power lines blocked Bishop Mead Road, Route 255 near Millwood, and 6 other secondary roads.
May 13, 2000	Temperatures in the mid 80s to lower 90s in combination with humid conditions resulted in several rounds of thunderstorms across Northern and Central Virginia from midday through late evening on the 13th. Several storms produced winds in excess of 55 MPH, large hail, frequent lightning, and very heavy downpours. The tornado moved into the Woodbrook neighborhood where it damaged a few homes and trees then dissipated. Hundreds of trees in the path of this 300 yard wide tornado were downed or snapped. In Page County, several trees and power lines were downed near Luray and Rileyville. One car on Cave Hill Road was hit by a falling tree. A homeowner on Yager Spring Road reported part of a roof peeled back and a downed chimney. Nearly 3,100 county customers lost power and two homes were hit by lightning. Pea to quarter sized hail fell in Luray. A computer in a home in Leaksville was melted by a bolt to lightning. Another home near the Shenandoah River Bridge was destroyed by fire after lightning struck. In Warren County, trees were damaged in Bentonville. In Shenandoah County, quarter to golf ball sized hail fell in New Market.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 15, 2000	<p>Trees were downed onto a house, barn, tent, and several roads. A line of thunderstorms that contained winds in excess of 55 MPH, large hail, heavy rain, and frequent lightning moved across the area during the afternoon and evening of the 15th. In Shenandoah County, trees were downed in New Market and Tom's Brook. The roof of a barn was also peeled back. Rainfall totals included 1.46 inches in Fetzer Gap and 1.34 inches at the Strasburg Reservoir. In Page County, a wind gust of 42 MPH was recorded in Luray. In Frederick County, dime sized hail fell on Route 522 north of Winchester. A tree was downed onto a power line in Winchester. Several structures across the county were hit by lightning. Heavy rain washed out Back Creek Road in the western portion of the county and flooded several streets in Winchester. A total of 2.11 inches fell in Winchester and 1.81 inches fell in Gore. In Warren County, several trees were downed onto roads, power lines, and structures across the county.</p> <p>Communities hardest hit included Shenandoah Farms, Front Royal, and Linden. A house was damaged by a downed tree in Rockland. A camper on Blue Mountain just outside of Front Royal was injured when a tree fell onto his tent. A 160-year-old house, a car, a fence, and a barn were damaged by several felled trees near Cedarville. Power lines were downed on Apple Mountain. Heavy rain flooded streets in Front Royal. Rainfall totals included 1.61 inches in Nineveh, 1.51 inches near Strasburg, and 1.31 inches on Hogback Mountain. In Clarke County, trees were downed and pea sized hail fell in Berryville. Power lines were downed across the county. Route 340 north of Berryville was blocked by downed trees.</p>
June 26, 2000	<p>Thunderstorms developed across the area on the afternoon of the 26th. The strongest storms produced winds in excess of 55 MPH, frequent lightning, and heavy rainfall. In Frederick County, a chimney was blown over and tree limbs were downed east of Winchester. Lightning also downed a tree onto a storage building in Winchester where an inch of rain fell in 15 minutes. In Clarke County, several trees were downed onto power lines, cars, and roads from Boyce south and east to the county line. Hardest hit areas included Boyce, Calmes Neck, Millwood, and Waterloo. Several trees were downed onto power lines, cars, and roads in Boyce and Millwood.</p>
July 10, 2000	<p>Thunderstorms that produced winds in excess of 55 MPH, large hail, frequent lightning, and heavy downpours moved across northern Virginia during the afternoon and evening of the 10th. In Shenandoah County, trees and power lines were downed from Edinburg to Woodstock. One felled tree destroyed a stoplight. A lightning strike damaged a school gymnasium in Woodstock. A total of 1.51 inches of rain fell in Zepp. In Page County, trees were downed near the Warren County border. In Warren County, trees were downed onto roads, a roof, and a car in Browntown.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
July 14, 2000	A cold front moved across the region during the evening of the 14th. Thunderstorms that developed ahead and along this front produced very heavy rainfall, large hail, and winds in excess of 55 MPH. In Page County, trees were downed north of Luray. A total of 2.11 inches of rain fell at Rocky Branch. In Warren County, rainfall totals included 1.70 inches in Strasburg and 1.61 inches in Nineveh.
July 29, 2000	Scattered thunderstorms that produced heavy rainfall moved across the central Shenandoah Valley during the afternoon of the 29th. In Shenandoah County, high winds damaged several structures and crops. The aluminum roof of a turkey barn was blown off and thrown 300 yards by high winds. Nearby, trees and corn crops were blown over and apples were blown off trees in an orchard. In addition, the roof of a well house was removed and a large white column was torn from the front porch of a house. A total of 1.66 inches of rain fell in New Market. In Page County, 1.74 inches fell at Lewis Mountain Camp.
August 9, 2000	A cold front moved across the region on the evening of the 9th. Thunderstorms that developed ahead and along the front produced winds in excess of 55 MPH, hail, frequent lightning, and isolated tornadoes. In Shenandoah County, an F0 tornado briefly touched down on property adjacent to Red Bank Road near Bowman's Crossing. The 15 yard wide twister started by sucking up water on the banks of the North Fork of the Shenandoah River. Next, it moved onshore and traveled north for two tenths of a mile. It downed or snapped five trees and flattened part of a corn field before dissipating. Straight line winds downed trees and power lines near New Market and Mt. Jackson. A wind gust of 42 MPH was recorded in Edinburg and hail fell in New Market. A barn roof and side were blown apart near Hayfield. Dime sized hail fell in Stephenson and Winchester. A tree was downed onto a power line on Amherst Street and lightning started an attic fire in Winchester where a wind gust of 40 MPH was recorded.
December 12, 2000	A vigorous cold front crossed the region on the 12th. As the front passed, northwest winds gusted up to 45 MPH and didn't begin to subside until midday. In Frederick County, numerous power line failures were reported. Downed trees caused power outages in 10 different areas, including Winchester. A wind gust of 46 MPH was recorded at the Winchester Airport. In Warren County, 6 trees were blown down at Massanutten Mountain Drive and High Knob Road. One downed power line sparked a brush fire.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
March 21, 2001	<p>A Nor'easter moved from the North Carolina Coast to New England from the 20th to the 22nd. As it passed by the Mid Atlantic region, it dropped heavy precipitation between midnight and mid afternoon on the 21st. Below 2,000 feet, the precipitation fell in the form of rain. Across the Shenandoah Valley and just east of the Blue Ridge Mountains, the storm system dropped between 2 and 5 inches of rain which resulted in flash flooding. Some of the highest regional rainfall totals included 4.44 inches at Big Meadows in Page County, and 4.36 inches at Strasburg Reservoir in Shenandoah County.. Numerous roads and low water crossings were closed by high water in Frederick, Page, Shenandoah, Warren, and Clarke Counties. The gusty winds downed a tree onto a shed near Conicville in Shenandoah County.</p>
May 27, 2001	<p>Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. In Shenandoah County, a home in Strasburg was struck by lightning. Marble sized hail was reported in Tom's Brook. Trees and power lines were downed by high wind in Orkney Springs. In Warren County, an F1 tornado touched down around 1 mile southwest of Ashby, just south of Route 639. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path.</p> <p>The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge. Several trees were downed on the roadway at this location. The tornado traveled to the northeast through woodlands, then dissipated about 5 miles east of Stone Bridge. In addition, a funnel cloud was spotted by a police officer over White Post, north of the storm. The officer followed the storm that produced the funnel cloud from White Post to Berryville and saw the funnel drop down several times, but never touch the ground. The only damage reported from this storm was from large amounts of golf ball sized hail that accumulated up to 6 inches in depth between Double Tollgate and White Post. The large hail damaged an asphalt roof, a flat membrane roof, and light fixtures. It was also responsible for chipping paint off a home and stripping leaves off vegetation.</p>

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 6, 2001	In Page County, a microburst of wind estimated between 60 and 70 MPH damaged several buildings in Jollett Hollow about 5 miles east of Shenandoah. The wind damage began at a small clearing adjacent to Jollett Road (Route 759) just south of Naked Creek Baptist Church. The damage path continued northeast onto private property where part of a roof was blown off a home and a car port was removed from its foundation. Pieces of the structure were thrown east about 100 yards onto the roof of a home. Several trees were uprooted and several outbuildings were destroyed nearby.
June 21, 2001	Thunderstorms that produced damaging winds and very heavy downpours moved across northern Virginia between 7 PM EDT on the 21st through 2 AM EDT on the 22nd. In Shenandoah County, numerous trees were downed in the southern portion of the county, including the community of Conicville. High winds ripped three quarters of a tin roof off a mobile home on Port Republic Road north of Grottoes. The remains of the tin roof were rolled into a ball and thrown 50 feet from the structure. A few trees were downed near the home but neighbors nearby did not report any damage. Heavy downpours flooded portions of Routes 611, 701, 724, 691, 672, 675, 1419, 667, 663, and 600. The Shenandoah River and Stoney Creek overflowed their banks in a few locations. A total of 3.04 inches of rain was reported at Jerome Gap. In Warren County, a wind gust of 53 MPH was recorded on Catlett Mountain Road. Trees were downed in the vicinity and a plane was damaged at the Warren County Airport nearby. In Page County, 3.67 inches of rain was reported at Rocky Branch, 2.14 inches was reported at Skyland, and 2.05 inches fell at Ida.
May 14, 2002	Trees and power lines were downed by winds that gusted to 58 MPH. A line of showers that produced damaging winds moved south through Northern Virginia between 3:30 and 5:30 PM EDT. In Frederick County, scattered trees and power lines were downed countywide, including the city of Winchester where a wind gust of 58 MPH was recorded. In Clarke County, numerous trees and power lines were downed, especially in the Berryville and Boyce areas. In Loudoun County, a wind gust of 61 MPH was recorded in Sterling at NOVA Community College. Trees and power lines were downed in Lovettsville, Hamilton, Round Hill, and Leesburg. In Lucketts, large trees were downed onto route 663 (Taylorstown Road). In Fairfax County, a tree was downed at the intersection of Route 123 and 236 in Fairfax. In Arlington County, downed trees and localized power outages were reported. In Stafford County, a few trees were downed. In Culpeper County, trees were downed in Culpeper. In Rappahannock County, trees were downed in Sperryville and Castleton. In Madison County, high winds downed trees onto Route 231 North. In Page County, trees were downed in the Luray area. In Shenandoah County, trees were downed in Fort Valley and a telephone pole was downed in Mt. Jackson. A wind gust of 43 MPH was recorded in New Market. In Rockingham County, lines were downed in Timberville. Property damage estimated at \$5,000.

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Table C-5. Hurricane & High Wind Hazard History

Date	Damages
June 5, 2002	Scattered thunderstorms moved through northern and central Shenandoah Valley, northern Virginia, the central foot hills, and central Piedmont during the late afternoon and evening of the 5th. In Warren County, trees and power lines were down countywide resulting in numerous power outages. Dime sized hail was reported in Front Royal. In Nineveh, 2.33 inches of rain fell. In Shenandoah County, trees were downed in seven different locations. In Clarke County, trees were downed near Berryville on Route 622.
June 11, 2003	Several trees were downed along Route 7 between Berryville and the Shenandoah River. An area of thunderstorms with high winds, hail, and heavy rainfall moved through the northern half of the state during the afternoon and evening of the 11th. In Nelson County, flooding was reported on the south side of Lovingsston. In Augusta County, water was flowing over Route 610 at Stuarts Draft. Trees were downed in New Hope and Middlebrook. In Staunton, numerous streets were turned into rivers by heavy downpours. In Clarke County, several trees were downed along Route 7 between Berryville and the Shenandoah River.
June 12, 2003	Several showers and thunderstorms moved through the northern third of Virginia during the afternoon and evening of the 12th. These storms contained very heavy rainfall and high winds. Several locations reported wind damage and flooding. In Shenandoah County, several roads were flooded. In Clarke County, a tree was downed onto a car near Berryville. Route 50 was closed by flooding 3 miles south of Boyce.
July 12, 2003	Trees were downed onto Bryarly and Gun Club roads. Thunderstorms with high winds and frequent lightning moved through extreme northwest Virginia during the late afternoon and evening of the 12th. In Frederick County, trees were downed onto Bryarly and Gun Club roads just north of Winchester. In Clarke County, trees and power lines were downed in Berryville. In Shenandoah County, high winds blew over or snapped trees in the Forest View area north of Edinburg. The damage was centered around Forest View Road. The Aileen Plant which had lost its roof in a February snowstorm lost a brick wall during this windstorm. Property damage estimated at \$3,000.
August 22, 2003	Thunderstorms with damaging winds and large hail moved through Northern Virginia during the evening of the 22nd. In Page County, a downburst of winds estimated between 70 and 80 MPH caused significant damage in Dovel Hollow near Stanley. The wind ripped the roof off of a 45 by 60 foot machine shed, threw it over a two story house, and it finally landed on Dovel Hollow Road nearly 300 yards away. Debris from the shed was thrown into the 2nd story of the home and caused significant damage to the front of the structure. The shed debris also damaged a pickup truck and tore wires off another home. In the vicinity several trees and power lines were also downed. Residents reported one half inch of rainfall in 15 minutes and hail.

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Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Frederick County	Frederick County	7/13/1961	F2	\$0.00	Description not available.
Frederick County	Frederick County	6/2/1962	F1	\$0.00	Description not available.
Warren County	Warren County	7/9/1970	F0	\$0.00	Description not available.
Clarke County	Clarke County	8/4/1975	F2	0	Description not available.
Clarke County	Clarke County	3/21/1976	F	0	Description not available.
Clarke County	Clarke County	8/2/1986	F1	0	Description not available.
Clarke County	Clarke County	8/2/1986	F1	\$0.00	Description not available.
Page County	Town of Stanley	9/27/1993	F1	\$0.00	A tornado touched down in Stanley damaging four homes and downing numerous trees and power lines which blocked roads.
Clarke County	Town of Berryville	6/18/1997	F0	\$1,000.00	A rapidly developing heavy-precipitation supercell produced several instances of severe weather over portions of the northern Shenandoah Valley and Piedmont regions of Virginia during the late afternoon and evening of the 18th. Four small tornadoes were confirmed. In Clarke Co, a third tornado touched down just south of Berryville. Minor damage was noted to a roof and shingles at a house; an electric garage door was damaged as well. A circular pattern was noted in the tall grass and in branches that had broken off nearby trees. Some tomato stakes and cages were pulled up and tossed. Scattered tree damage was noted elsewhere across the six-county area, including the towns of Reliance (Warren Co), Middletown and Stephens City (Frederick Co), White Post and Berryville (Clarke Co).

**Northern Shenandoah Valley Multi-Jurisdictional
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Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Frederick County	Duoble Tollgate	6/18/1997	F0	\$2,000.00	The Wheatfield twister (from the heavy precipitated supercell) lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating. The second small tornado touched down east of Klines Corner in southeast Frederick Co. Five trees were downed on one farm, and damage was spotty along a 3-mile path to Double Church Road just southwest of Double Tollgate. A spotter had previously reported a touchdown near this area. Most of the damage was to trees, though some minor roof and fence damage was observed along and near Double Church Road.
Shenandoah County	Wheatfield	6/18/1997	F1	\$0.00	Damage in Wheatfield was confined to a heavily wooded rural area, where 20 trees were snapped or uprooted along a narrow but distinctive path. Winds were estimated to be around 80 mph. It was the first tornado ever reported in the county; perhaps partially due to a NWS survey team locating the damage. The twister lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating.
Clarke County	Berryville	6/2/1998	F0	\$0.00	The combination of an upper level disturbance, increasing atmospheric shear, and ample instability set the stage for a severe weather episode across northwestern Virginia during the evening. Individual mini-supercell storms contained large hail, damaging winds, and a few small tornadoes. The storms originated in eastern Ohio during the late afternoon and propagated through southwestern Pennsylvania, extreme northwestern Virginia, and portions of eastern West Virginia before scooting into northern Virginia. Two weak tornadoes, emanating from the same mini-supercell, struck in Clarke and Loudoun Cos. Damage was noted near Berryville (Clarke Co) in the form of several uprooted trees and an unroofed barn. In western Loudoun Co, tree damage indicative of a tornado was surveyed along Snickersville Turnpike (local route 734). Elsewhere in northern Virginia, the main culprit was large hail, ranging in diameter from three-quarters of an inch to golf ball (1.75 inches). Damage likely occurred to some crop fields - the hail, in most cases, lasted from 5 to 15 minutes.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Frederick County	Clear Brook	6/16/1998	F1	\$50,000.00	Like a broken record, severe weather erupted again in northern and western Virginia - exactly one day after thunderstorms pounded many of the same areas. This time around, a cold front aided in triggering the episode, though upper-level wind shear was a major player in destabilizing the atmosphere much like it had done the previous day. Incredibly, the 16th would be the third out of four afternoons that severe weather had occurred in some portion of northern and western Virginia. A comma-shaped line of thunderstorms - indicative of a mesoscale low pressure system - developed by the middle of the afternoon. The comma "head" curled from eastern West Virginia into western Maryland, then formed a line through western and central Virginia. Several tornadoes touched down in the vicinity of the comma head, from extreme northwestern Virginia through eastern West Virginia and northern and western Maryland. A small tornado struck in and northeast of Clear Brook (northeast Frederick Co), uprooting at least 7 maple trees, smashing a storm window, flattening a barn, and snapping or uprooting 24 additional trees along Grace Church Road. Allegheny Power reported 2,300 customers lost electricity in Frederick Co alone.
Frederick County	Gainesboro	7/30/1998	F0	\$0.00	An isolated rotating thunderstorm developed along a stationary front over western Frederick Co and moved east, producing some wind damage and a small tornado near and east of Gainesboro. At a residence on Hunting Ridge Road just east of Gainesboro, a brief tornado snapped or uprooted 50 to 60 trees, including pines and oaks. One of the trees smashed a portion of a fence. Moments earlier, in Gainesboro, lightning started two grass fires and struck a home, causing minor damage. Strong winds blew down several power lines as well.

**Northern Shenandoah Valley Multi-Jurisdictional
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Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Shenandoah County	Bowman	8/9/2000	F0	\$0.00	A 15 yard wide tornado briefly touched down on the banks of the North Fork of the Shenandoah River near Bowman's Crossing. It downed trees and corn as it traveled north for two tenths of a mile. A cold front moved across the region on the evening of the 9th. Thunderstorms that developed ahead and along the front produced winds in excess of 55 MPH, hail, frequent lightning, and isolated tornadoes.
Clarke County	Millwood	5/27/2001	F1	\$0.00	A tornado that came from Warren County downed trees across Route 624 (Millville Rd). Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley between 1 and 3 PM EDT and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path. The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge. Several trees were downed on the roadway at this location. The tornado traveled to the northeast through woodlands, then dissipated about 5 miles east of Stone Bridge. In addition, a funnel cloud was spotted by a police officer over White Post, north of the tornadic storm. The officer followed the storm that produced the funnel cloud from White Post to Berryville and saw the funnel drop down several times, but never touch the ground. The only damage reported from this storm was from large amounts of golfball sized hail that accumulated up to 6 inches in depth between Double Tollgate and White Post. The large hail damaged an asphalt roof, a flat membrane roof, and light fixtures. It was also responsible for chipping paint off a home and stripping leaves off vegetation.

**Northern Shenandoah Valley Multi-Jurisdictional
Hazard Mitigation Plan**

Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Warren County	Ashby	5/27/2001	F1	\$0.00	Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley between 1 and 3 PM EDT and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. In Warren County, an F1 tornado touched down around 1 mile southwest of Ashby, just south of Route 639. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path. The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge.
Shenandoah County	Quicksburg	4/28/2002	F2	\$0.00	A long-lived supercell thunderstorm formed over northwest Rockingham County. While the storm moved through North Central Virginia, it produced an F2 tornado in Shenandoah County, a significant funnel cloud in Fauquier County, large hail, heavy downpours, and scattered wind damage. In Shenandoah County, an F2 tornado touched down just east of Quicksburg near the intersection of Quicksburg Road and Old Bridge Road. The tornado stayed on the ground for 4 miles before it dissipated while moving up the west side of Massanutten Mountain. The twister was estimated to be about 75 yards wide and it caused a total of \$1.6 million in damage. Along the path of the tornado, three residential structures were destroyed, 12 structures were heavily damaged, and 15 had minor damage. Four poultry houses and 15 barns were destroyed. Five poultry houses, two silos, and a mile of fencing was also damaged. On Old Bridge Road, a silo and three barns were damaged. Airborne roof debris and high winds hit a tractor-trailer on I-81 and caused it to flip onto its side. The driver of the tractor-trailer was treated for minor injuries.

**Northern Shenandoah Valley Multi-Jurisdictional
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Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
					The tornado moved across I-81 and Route 11 into the Kay Hill subdivision. Homes were damaged and trees were downed on Lower and Upper Forge Road. A mobile home on Mantz Drive was destroyed. The tornado moved east across Smith Creek to Smith Creek Road and Franwood Lane where it caused significant damage. A two-story home just off Smith Creek Road was severely damaged by debris from a neighbor's 60-foot-high grain silo. A woman inside the structure was treated for bruises. On Franwood Lane, two turkey houses were destroyed and four were severely damaged. One dog that lived on the property was killed and another was injured. A cat was never found. A shed was damaged and work equipment was scattered across the property. At Franwood Farms Airport, 5 people took shelter from the storm in a hangar. A person in the hangar said the walls kept coming closer together as the tornado approached and eventually the roof blew off the building. The tornado also flipped a plane on the landing strip. The tornado's path was visible up to two miles east of Franwood Farms through a path of damaged trees in the forest. The path of tree damage ended as the topography sloped up Massanutten Mountain into George Washington National Forest. In addition, an orchard west of Mt. Jackson just north of the tornado's path, sustained hail damage. Power lines were downed in Stanley. The time series of photos shows the funnel never reaching the ground.
Clarke County	Town of Berryville	9/8/2004	F0	\$0.00	A weak tornado touched down briefly just 2 miles north of Berryville and the intersection of Route 7 and U.S. Highway 340. A few trees were snapped off with a lot of shredded leaves on the ground. Maximum winds were around 65 mph.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Frederick County	Town of Middletown	9/17/2004	F1	\$0.00	A tornado touched down in western Frederick County, Virginia on the 17th. The path of the storm was 9 miles long. It touched down about one mile east of Middletown and Interstate 81. Roof damage was noted to many barns and outbuildings. A large two story brick garage was nearly destroyed when its roof was blown off from strong F1 tornado winds. In the western end of the Stonebrook Farm Subdivision, an estimated 100 oak and other hardwood trees ranging from 18 to 36 inches in diameter topped or snapped 20 to 50 feet up from the base in roughly a 2 block area. One home was completely destroyed and over 100 others damaged due to falling trees.
Frederick County	Winchester Airport	9/17/2004	F2	\$0.00	An F2 tornado produced a nearly continuous path of damage for 5 miles in eastern Frederick County. It touched down west of Millwood Pike near the Winchester Airport. Three homes suffered roof damage, a detached two car garage was destroyed, a platform deck was blown away, an office trailer was overturned, and numerous trees along the track of the storm were uprooted or topped.
Warren County	Town of Front Royal	9/17/2004	F0	\$0.00	A weak tornado produced minor damage to some large trees near Front Royal. Debris was thrown across several roads.

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
59129	4/12/1990	3124 Valley Ave.	Winchester	Winchester	VA	22601	Rubbermaid Corp.	Fixed	Water	Hydraulic Oil
47741	11/14/1990	320 N Hawksbill	Page	Luray	VA	22835	Wrangler Inc.	Pipeline	Land	Oil, Fuel: No. 5
60463	2/15/1991	Kendrick Ln	Warren	Front Royal	VA	22630	Avtex Fibers	Fixed	Land	Oil, Misc: Transformer
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	5 Gallon Tar Buckets
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	Old Rusty Drum
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	Paint Cans
71229	5/1/1991	St. Rt. 730	Shenandoah	Mount Jackson	VA	(Null)	(Null)	Aircraft	Land	Unknown Material
76001	6/15/1991	Rt 3, Box	Page	Luray	VA	22835	(Null)	Mobile	Land	Oil, Misc: Motor
77911	6/30/1991	Rt 665 Mill Rd	Shenandoah	Woodstock	VA	22664	Woodstock Water Treat Fac	Fixed	Land	Chlorine
83157	8/9/1991	1944 Valley Avenue	Winchester	Winchester	VA	22601	O'sullivan Corporation	Mobile	Water	Topcoat (Vinyl Sheeting Spray)
86156	8/19/1991	State Rt 672	Clarke	Berryville	VA	22611	Mark's Metal Shop	Fixed	Air	Asbestos

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
88745	9/17/1991	1317 Caroline St	Winchester	Winchester	VA	(Null)	Chemlawn	Mobile	Water	Tank Mix(Fertilizer & Weed Control)
91481	10/6/1991	Off Of Rt 654 Andblackbear Crossing	Shenandoah	Shenandoah	VA	(Null)	(Null)	Fixed	Land	Oil, Misc: Motor
96940	11/20/1991	E King St	Shenandoah	Strasburg	VA	22657	Valley Milk Products	Fixed	Air	Ammonia, Anhydrous
98624	12/6/1991	360 Fox Drive	Winchester	Winchester	VA	22601	(Null)	Fixed	Land	Oil, Fuel: No. 2
102570	1/12/1992	Rt No.672 .6 Of A Mileeast Of Intersection661 And 672	Clarke	Berryville	VA	(Null)	(Null)	Fixed	Land	Polypropylene
112058	3/27/1992	I-81 At Rt 50 Exit	Winchester	Winchester	VA	(Null)	(Null)	Mobile	Land	Oil: Diesel
118488	5/20/1992	Rt 50 And 340	Clarke	Clarke	VA	(Null)	Lofton's Texaco	Fixed	Land	Gasoline: Automotive (4.23g Pb/G
118976	5/24/1992	York Haven Marinajust Off Browns Neck Rdcounty=Poquoson	Page	Page	VA	23662	(Null)	Vessel	Water	Gasoline: Automotive (4.23g Pb/G
122244	6/17/1992	King David Drive	Warren	Warren	VA	(Null)	(Null)	Mobile	Land	Unknown Oil
126978	7/10/1992	Rt 11 N	Winchester	Winchester	VA	22602	L J Wright	Fixed	Water	Oil: Diesel
127887	7/21/1992	Newport Substation	Page	Shanendoah Town	VA	(Null)	Potomac Edison	Fixed	Land	Oil, Misc: Transformer
133103	8/22/1992	Off Rt 677	Frederick	Frederick	VA	22601	(Null)	Fixed	Water	Citronella, Outdoor Lamp Oil
138183	9/25/1992	522 S Front Royal	Warren	Front Royal	VA	22630	Rappewan Inc	Fixed	Land	Oil: Diesel

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
142363	10/24/1992	Rt 614behind Baker Trucking	Shenandoah	Mount Jackson	VA	(Null)	Floyd E. Baker Trucking	Mobile	Land	Unknown Oil
148374	12/8/1992	Virginian Truck Stoproute 81mile Marker 291	Shenandoah	Toms Brook	VA	(Null)	Palm Commodities Int	Mobile	Land	Nickel Sulphate Liquid
159410	2/23/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	O'sullivan Corp	Fixed	Land	Methyl Isobutyl Ketone
165334	3/15/1993	Hwy 619	Page	Stanley	VA	22851	(Null)	Fixed	Water	Waste Oil/Lubricants - Poss. Con
162299	3/15/1993	Route 522	Winchester	Winchester	VA	(Null)	Shenandoah Gas Co	Fixed	Air	Ethylene Glycol
163386	3/21/1993	Rt 11 South	Frederick	Middletown	VA	22645	Miles Inc.	Fixed	Land	Trichloroethylene
165766	4/4/1993	Summit Point Rdacross From County Rd 666	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	(Null)
166848	4/9/1993	1436 Pack Horse Rd	Winchester	Winchester	VA	22603	(Null)	Unknown Sheen	Water	Unknown Material
167625	4/15/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	Chemical Leman	Mobile	Water	Semi-Gloss Topcoat Vinyl Material
175713	5/23/1993	213 Walton St	Shenandoah	Strasburg	VA	22657	(Null)	Fixed	Land	Kerosene
205784	11/1/1993	Dot No. Unknowncnty Rd Unknown No.	Shenandoah	Strasburg	VA	(Null)	(Null)	Railroad Non-Release	Rail Report (N/A)	(Null)
210161	11/29/1993	Route 3 Box 370	Shenandoah	Shenandoah	VA	22824	Rocco Farm Foods Inc	Fixed	Air	Chlorine
212412	12/13/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Mobile	Water	Oil, Fuel: No. 2-D

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
215928	1/9/1994	(Null)	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Land	Oil, Misc: Lubricating
218024	1/22/1994	Between The Shannondoahcompressor Station & Thebickers Compressor Sta	Page	Page	VA	(Null)	Columbia Gas Transmisson	Pipeline	Air	Natural Gas
231789	3/2/1994	Corner Of Steps To Heavenand Dooms Peak	Warren	Warren	VA	22642	Skyland Estates	Mobile	Land	Oil, Misc: Motor
231789	3/2/1994	Corner Of Steps To Heavenand Dooms Peak	Warren	Warren	VA	22642	Skyland Estates	Mobile	Land	Oil: Diesel
236922	4/27/1994	501 Stickley Dr	Frederick	Stephens City	VA	22655	(Null)	Mobile	Water	Oil, Misc: Motor
242208	6/3/1994	Avtex Fiberskendrick Lane	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Land	Unknown Oil(Unknown Type Fuel Oil)
244131	6/15/1994	(Null)	Shenandoah	Shenandoah	VA	(Null)	Norfolk Southern	Railroad	Land	Hydraulic Oil
244113	6/15/1994	(Null)	Shenandoah	Strasburg	VA	(Null)	Norfolk Southern	Fixed	Land	Hydraulic Oil
250802	7/20/1994	Rt 34522 Northnorth Fork Of Shenandoahriver (Vic. Bridge)	Warren	Front Royal	VA	22651	(Null)	Unknown Sheen	Water	Unknown Material
257478	8/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	All Frieight	Mobile	Land	Paint
258917	9/3/1994	Leroy's Marinalittle Wicomoco River	Clarke	Clarke	VA	(Null)	M/V Ballroom Buddy	Vessel	Water	Gasoline: Automotive (Unleaded)
262375	9/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Fixed	Land	Acetone
262375	9/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Fixed	Land	Methyl Ethyl Ketone

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
272303	12/7/1994	(Null)	Winchester	Winchester	VA	(Null)	(Null)	Mobile	Unknown	(Null)
272746	12/10/1994	St Rte 661dot 468631w	Warren	Warren	VA	(Null)	(Null)	Railroad Non-Release	Rail Report (N/A)	(Null)
273013	12/12/1994	Route 3 Box 5940route 608	Clarke	Berryville	VA	(Null)	Glenn Owen	Fixed	Air	Creosote, Coal Tar
274680	12/28/1994	304 Liberty St	Clarke	Berryville	VA	66211	Mercer's Oil Co	Fixed	Land	Oil, Fuel: No. 2
282848	3/11/1995	1944 Valley Ave	Winchester	Winchester	VA	22601	O'sullivan Corp	Fixed	Water	Mobilsol A
288921	4/27/1995	Middle Rd And Rte 55	Frederick	Stephens City	VA	(Null)	(Null)	Unknown Sheen	Land	Oil, Fuel: No. 2-D
290102	5/5/1995	Intersection Of State Rt703 And Route 11	Shenandoah	Mount Jackson	VA	(Null)	(Null)	Railroad Non-Release	Land	Oil, Fuel: No. 2-D
308642	9/25/1995	1944 Valley Ave	Winchester	Winchester	VA	22601	Manfredi Motor Transit	Mobile	Water	Solvent
314349	11/15/1995	Ricketts Dr And Southloudoun St	Winchester	Winchester	VA	22601	(Null)	Unknown Sheen	Water	Unknown Oil
321457	1/20/1996	Across River Fm Thefront Royal County Clubon East Side	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Water	Unknown Material
322275	1/25/1996	Strasburg Handymart232 West King St	Shenandoah	Strasburg	VA	(Null)	Hn Funkhouser & Co	Fixed	Water	Kerosene
328776	2/22/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Land	Ethyl Chloride
330624	3/12/1996	(Null)	Page	Shenandoah Town	VA	(Null)	Norfolk Southern	Railroad	Land	Oil, Misc: Lubricating
330797	3/12/1996	Pawaton Rd	Shenandoah	Strasburg	VA	(Null)	Ag Mark	Fixed	Air	Unknown Material

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
354614	8/2/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Air	Ethyl Chloride
358453	8/26/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Air	Ethyl Chloride
362162	9/9/1996	Rt 616pole #F1334sa22	Page	Page	VA	(Null)	Virginia Power	Fixed	Water	Oil, Misc: Transformer (Unknown If Pcb)
368458	11/23/1996	404 Kendrick Lane	Warren	Front Royal	VA	(Null)	Epa Iii	Fixed	Water	Untreated Discharge Water From Lagoon
371690	12/29/1996	Mp H-106rail Yard	Page	Shanendoah Town	VA	30303	Norfolk Southern Rr	Railroad	Land	Oil, Fuel: No. 2-D
378528	2/28/1997	811 Junior Ave	Page	Shanendoah Town	VA	(Null)	Jvk Precision	Fixed	Land	Waste Oil
397200	7/29/1997	(Null)	Page	Stanley	VA	(Null)	Norfolk Southern	Fixed	Land	Oil, Misc: Transformer(Pcb Content Unknown)
397207	7/29/1997	(Null)	Page	Stanley	VA	(Null)	(Null)	Fixed	Land	Polychlorinated Biphenyls
407329	10/10/1997	Lake Holiday Country Club231 Redland Rd	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Gasoline: Automotive (4.23g Pb/G
407329	10/10/1997	Lake Holiday Country Club231 Redland Rd	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Oil, Misc: Motor

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
408266	10/20/1997	On Access Road Leading To Johns Manville manufacturing	Shenandoah	Shenandoah	VA	22824	Johns Manville	Fixed	Water	Asphalt(Emulsion)
409810	10/31/1997	No Address	Page	Shenandoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Oil, Misc: Lubricating
409825	10/31/1997	505 First St	Page	Shenandoah Town	VA	(Null)	Norfolk Southern	Railroad	Land	Oil, Misc: Lubricating
415412	12/11/1997	Hwy 340	Page	Stanley	VA	22851	Wompler Foods	Fixed	Air	Chlorine
425998	2/25/1998	5 Longstreet Ave	Clarke	Clarke	VA	(Null)	(Null)	Fixed	Land	Oil, Fuel: No. 2
425951	2/25/1998	450 Old Depo Rd.	Shenandoah	New Market	VA	(Null)	Kennametal	Fixed	Water	Trim-Vhpe 210 , Miscible
439016	5/28/1998	First St	Page	Shenandoah Town	VA	(Null)	Lcm Inc	Railroad	Land	Naphtha: Solvent
439567	6/1/1998	1502 Martinsburg Pike	Winchester	Winchester	VA	(Null)	Tenneco Packing Co	Fixed	Air	Ethyl Chloride
444848	7/7/1998	1502 Martinsburg Pike	Winchester	Winchester	VA	(Null)	Tenneco Packing Co	Fixed	Air	Ethyl Chloride
451148	8/14/1998	227 Conincille Roadi-81 Exit 273	Shenandoah	Mount Jackson	VA	(Null)	Sheetz Inc	Unknown Sheen	Water	Oil: Diesel
457212	9/25/1998	3rd House On The Left Oncedar Lane	Clarke	Clarke	VA	20135	(Null)	Fixed	Water	Oil: Diesel
460278	10/16/1998	Route 3, Box 5980	Clarke	Berryville	VA	22611	Mercer Oil Co	Fixed	Land	Unknown Oil
461686	10/28/1998	(Null)	Page	Shenandoah Town	VA	(Null)	Norfolk Southern Corp	Railroad	Land	Lube Oil
466401	12/4/1998	(Null)	Shenandoah	Shenandoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Borate

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
479108	4/3/1999	Virginia Divisionmm H107.4	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Oil, Misc: Lubricating
504558	6/3/1999	2840 Us Highway 211 East	Page	Luray	VA	22835	Brookside Restaurant	Fixed	Water	Gray Water
495372	8/13/1999	Fairfax Pike Or Route 277and Stephens City	Frederick	Stephens City	VA	22655	Wes's Truck And Traylor	Fixed	Air	Refrigerant Gases
495385	8/17/1999	Vacant Lot In 170 Blockon Bixler Ferry Road	Page	Luray	VA	(Null)	Town Of Luray	Fixed	Land	Construction Trash (Broken Glass/Steel/Asphalt/Cement)
495883	8/21/1999	Milepost:H106.7	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Aggregate Limestone
497991	9/8/1999	605 North Loudon Street	Winchester	Winchester	VA	22601	Winchester Cold Storage	Fixed	Air	Ammonia, Anhydrous
500614	9/28/1999	522 North	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Gasoline: Automotive (Unleaded)
505472	11/11/1999	I-81 At Exit 323flying J	Frederick	Frederick	VA	(Null)	Crst International	Mobile	Water	Oil, Fuel: No. 2-D
509589	12/20/1999	Route 684	Winchester	Winchester	VA	(Null)	Quarles Petroleum Inc	Mobile	Air	Propane
520836	2/15/2000	Flying J Truck Stop Hwy 181 North	Winchester	Winchester	VA	(Null)	Flying J Truck Stop	Fixed	Land	Raw Sewage
520836	2/15/2000	Flying J Truck Stop Hwy 181 North	Winchester	Winchester	VA	(Null)	Flying J Truck Stop	Fixed	Land	Unknown Oil
521125	2/22/2000	246 Dick's Hollow Rd	Winchester	Winchester	VA	22603	(Null)	Fixed	Water	Oil, Fuel: No. 2-D

Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Ethylene Glycol
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Oil, Misc: Motor
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Oil: Diesel
525960	4/11/2000	806 Us Hwy 340just To The Left Of The Scalehouse By The Dumpsters	Page	Luray	VA	(Null)	Page County Landfill	Fixed	Water	Battery Acid
525960	4/11/2000	806 Us Hwy 340just To The Left Of The Scalehouse By The Dumpsters	Page	Luray	VA	(Null)	Page County Landfill	Fixed	Water	Waste Oil
527930	5/3/2000	I-81 South	Warren	Strasburg	VA	(Null)	Dupre Transport Inc.	Mobile	Soil	Oil, Fuel: No. 2-D
528335	5/7/2000	1117 Lakeview Drive	Frederick	Frederick	VA	22625	(Null)	Pipeline	Water	Raw Sewage
537757	8/5/2000	Truck Stop On Main Street In Stevens City5116 Main Street	Frederick	Stephens City	VA	(Null)	High Point Truck Stop	Fixed	Land	Oil, Fuel: No. 2
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Carbon Disulfide
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Hydrogen Sulfide
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Sulfuric Acid
543190	9/25/2000	109 Blue Bell Ave	Page	Luray	VA	22835	Bridge Terminal Transport	Mobile	Water	Oil: Diesel

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
546542	10/25/2000	Across From 135 N. Main St.	Shenandoah	Woodstock	VA	22664	Woodstock Fire Company	Fixed	Air	Gasoline: Automotive (Unleaded)
546630	10/28/2000	Mcdonald Road	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	Waste Oil
548533	11/17/2000	Off Of Rte 620	Clarke	Clarke	VA	(Null)	(Null)	Fixed	Water	Oil, Misc: Transformer
551739	12/21/2000	1014 Mt Olive Rd	Shenandoah	Toms Brook	VA	22660	A.T. Williams Oil Company	Storage Tank	Land	Oil, Fuel: No. 2-D
554326	1/21/2001	1014 Mt Olive Rd	Shenandoah	Toms Brook	VA	22660	A.T. Williams Oil Company, Inc.	Storage Tank	Unknown	Oil, Fuel: No. 2-D
559845	3/10/2001	Right Off West Maine St, On Kendrick Lane	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Air	Unknown Material
573088	7/16/2001	440 Kindred Lane	Warren	Front Royal	VA	22630	Fmc Corp	Pipeline	Water	Impacted Storm Waters
576338	8/12/2001	I-81 / Mile Marker 279	Shenandoah	Mount Jackson	VA	(Null)	Western Express	Mobile	Land	Oil, Fuel: No. 2-D
582106	10/5/2001	On The Track	Warren	Front Royale	VA	(Null)	(Null)	Railroad	Ballast	Calcium Chloride
584990	11/2/2001	704 Woodlawn Ave.	Warren	Front Royal	VA	(Null)	Valley Discount Fuel	Fixed	Land	Oil, Fuel: No. 2-D
585417	11/7/2001	Industrial Park	Shenandoah	Mount Jackson	VA	(Null)	Merlot Cabinet	Fixed	Air	Unknown Material
587312	11/29/2001	1696 Oranda Rdpob 7151	Shenandoah	Strasburg	VA	22657	Global Stone Chemstone	Fixed	Soil	Oil, Fuel: No. 2-D
587952	12/6/2001	6347 Winchester Rd (Rte 522)	Warren	Warren	VA	(Null)	(Null)	Storage Tank	Water	Unknown Oil

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
590599	1/2/2002	Within The The Processing Plant1992 Senedo Rd	Shenandoah	Shenandoah	VA	22824	Georgia's Chicken	Pipeline	Air	Ammonia, Anhydrous
601383	4/30/2002	Sub Stationintersection Of Rt 675 And Rt 779	Shenandoah	Shenandoah	VA	(Null)	(Null)	Fixed	Land	Oil, Misc: Transformer (Non Pcb)
619137	8/6/2002	158 West Parkins Mill Road	Winchester	Winchester	VA	(Null)	West Parkins Mill Water Treatment Facili	Storage Tank	Air	Chlorine
619179	8/6/2002	Parkins Mill Waste Water Treatment Plant158 West Parkins Mill Road	Winchester	Winchester	VA	(Null)	Frederick County Sanitation Authority	Storage Tank	Air	Chlorine
622039	9/4/2002	1226 N Frederick Pike	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	Transmission Fluid
626908	9/20/2002	Private Well107 Tee Court	Warren	Warren	VA	22642	(Null)	Fixed	Water	Polychlorinated Biphenyls
625771	10/11/2002	I-81 South At Mile Marker 271.5.	Shenandoah	Mount Jackson	VA	(Null)	Trl	Mobile	Water	Oil: Diesel
640049	3/20/2003	1944 Valley Ave.	Winchester	Winchester	VA	(Null)	Poly One Corp	Mobile	Water	Hydraulic Oil
641424	4/5/2003	In Front Of Below Address203 Juniper Drive	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Water	Oil, Misc: Motor
650797	7/14/2003	7961 Winchester Rd	Warren	Fort Royal	VA	22630	Dupont	Storage Tank	Land	Clear Coat(Company Product)
652150	7/27/2003	550 Fairmont Ave	Winchester	Winchester	VA	(Null)	National Fruit Products Company	Fixed	Air	Ammonia, Anhydrous

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
652379	7/30/2003	Devil Jump.	Page	Luray	VA	(Null)	(Null)	Pipeline	Water	Raw Sewage
652666	8/1/2003	National Fruit Product Warehouse Building 37a550 Fairmont Avenue	Winchester	Winchester	VA	22601	A & S Transport	Mobile	Water	Oil, Fuel: No. 2-D
652877	8/4/2003	Railroad Milepost H53.0 / Subdivision: Virginia	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Hydraulic Oil
654741	8/22/2003	550 Fairmont Avenue	Winchester	Winchester	VA	22601	National Fruit Product Co.	Fixed	Air	Ammonia, Anhydrous
701421	9/25/2003	427 North Cameron St	Winchester	Winchester	VA	(Null)	Zirkle Sheet Metal Incorp.	Fixed	Air	Freon
705330	11/14/2003	Shenandoah County Municipal Landfill	Shenandoah	Shenandoah	VA	(Null)	Shenandoah County Municipal Landfill	Fixed	Air	Refrigerant Gases
707088	12/3/2003	I-81 South Bound At Exit 315	Winchester	Winchester	VA	(Null)	Penatere Brothers Inc	Mobile	Land	Oil, Fuel: No. 2-D
711758	1/28/2004	Us 340 Maintenance St., Milepost H95.5	Page	Stanley	VA	(Null)	Norfolk Southern Railroad	Mobile	Ballast	Hydraulic Oil
712515	2/3/2004	Medianroute 66 Westbound, Milemarker 11	Warren	Front Royale	VA	(Null)	Burgess Trucking	Mobile	Water	Oil, Fuel: No. 2-D
712515	2/3/2004	Medianroute 66 Westbound, Milemarker 11	Warren	Front Royale	VA	(Null)	Burgess Trucking	Mobile	Water	Oil, Misc: Motor
715634	3/7/2004	256 Mason St.	Winchester	Winchester	VA	(Null)	(Null)	Storage Tank	Water	Oil, Fuel: No. 2
719330	4/19/2004	312 Walnut St.	Clarke	Clarke	VA	22611	Mercer Oil	Storage Tank	Land	Oil, Fuel: No. 2
721042	5/7/2004	545 Radio Station Road	Shenandoah	Strasburg	VA	22657	(Null)	Mobile	Land	Oil: Diesel

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
723280	5/27/2004	Milepost B45.6 On Westbound Main Track Of Norfolk Southern	Warren	Front Royal	VA	(Null)	Norfolk Southern	Railroad	Ballast	Tylex
723269	5/27/2004	Mm: B-45.2	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Land	Oil: Diesel
724177	6/7/2004	7961 Winchester Rd	Warren	Fort Royal	VA	22630	Dupont	Railroad	Land	Solvent Blend
724456	6/9/2004	311 North Commerce Street	Warren	Front Royal	VA	22630	(Null)	Fixed	Land	Chlorine
733171	8/20/2004	Chicken Processing Plant - Corner Of East Old Cross & Johns Seviercorner Of East Old Cross & Johns Sevier	Shenandoah	New Market	VA	(Null)	Chicken Processing Plant	Fixed	Air	Ammonia, Anhydrous
733331	8/26/2004	Lakepost Road	Clarke	Clarke	VA	(Null)	(Null)	Storage Tank	Land	Unknown Oil
737965	10/11/2004	Norfolk Southern Railyard Mile Post H-106.3	Page	Shanendoah Town	VA	(Null)	(Null)	Mobile	Land	Hydraulic Oil
739774	10/24/2004	11829 Orkney Grade	Shenandoah	Mount Jackson	VA	22842	(Null)	Storage Tank	Water	Oil, Fuel: No. 2
752601	3/13/2005	Rail Yard, Milepost H-106	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Soy Holls (Type Of Feed)
754222	3/30/2005	Mile Post H106	Page	Shanendoah Town	VA	(Null)	(Null)	Railroad	Ballast	Crank Case Oil
757892	5/6/2005	Milepost H-95.0	Page	Stanley	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Oil, Misc: Lubricating
776979	10/21/2005	I-81 Sb Near Mm 272	Shenandoah	Mount Jackson	VA	(Null)	Estes Express Line	Mobile	Land	Oil, Fuel: No. 2-D

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Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
777096	10/22/2005	Unknown Sheen Incident, Happy Creek, Jackson Street, Near The Bridge	Warren	Front Royal	VA	(Null)	(Null)	Unknown Sheen	Water	Unknown Oil
777595	10/26/2005	Mile B46.0	Warren	Front Royal	VA	(Null)	Norfolk Southern Railroad	Railroad	Soil	Oil: Diesel

Northern Shenandoah Valley Multi-Jurisdictional
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Appendix D – Jurisdiction Specific Mapping

Relative Snowfall Potential

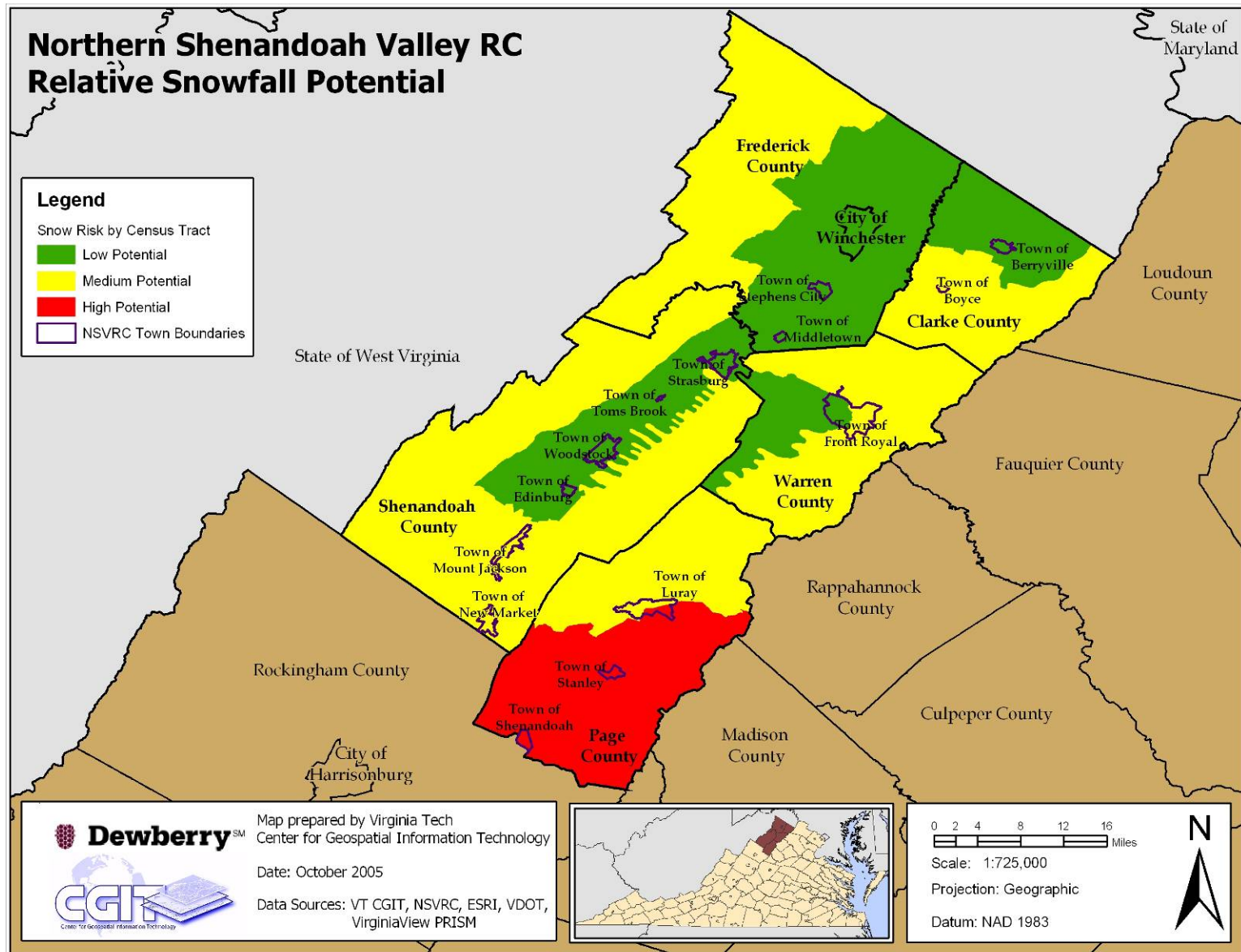
Northern Shenandoah Regional Map	D-3
Clarke County	D-4
<i>Town of Berryville</i>	D-5
<i>Town of Boyce</i>	D-6
Frederick County	D-7
<i>Town of Middletown</i>	D-8
<i>Town of Stephens City</i>	D-9
Page County	D-10
<i>Town of Luray</i>	D-11
<i>Town of Stanley</i>	D-12
<i>Town of Shenandoah</i>	D-13
Shenandoah County	D-14
<i>Town of Edinburg</i>	D-15
<i>Town of Mount Jackson</i>	D-16
<i>Town of New Market</i>	D-17
<i>Town of Strasburg</i>	D-18
<i>Town of Toms Brook</i>	D-19
<i>Town of Woodstock</i>	D-20
Warren County	D-21
<i>Town of Front Royal</i>	D-22
City of Winchester	D-23

**Northern Shenandoah Valley Multi-Jurisdictional
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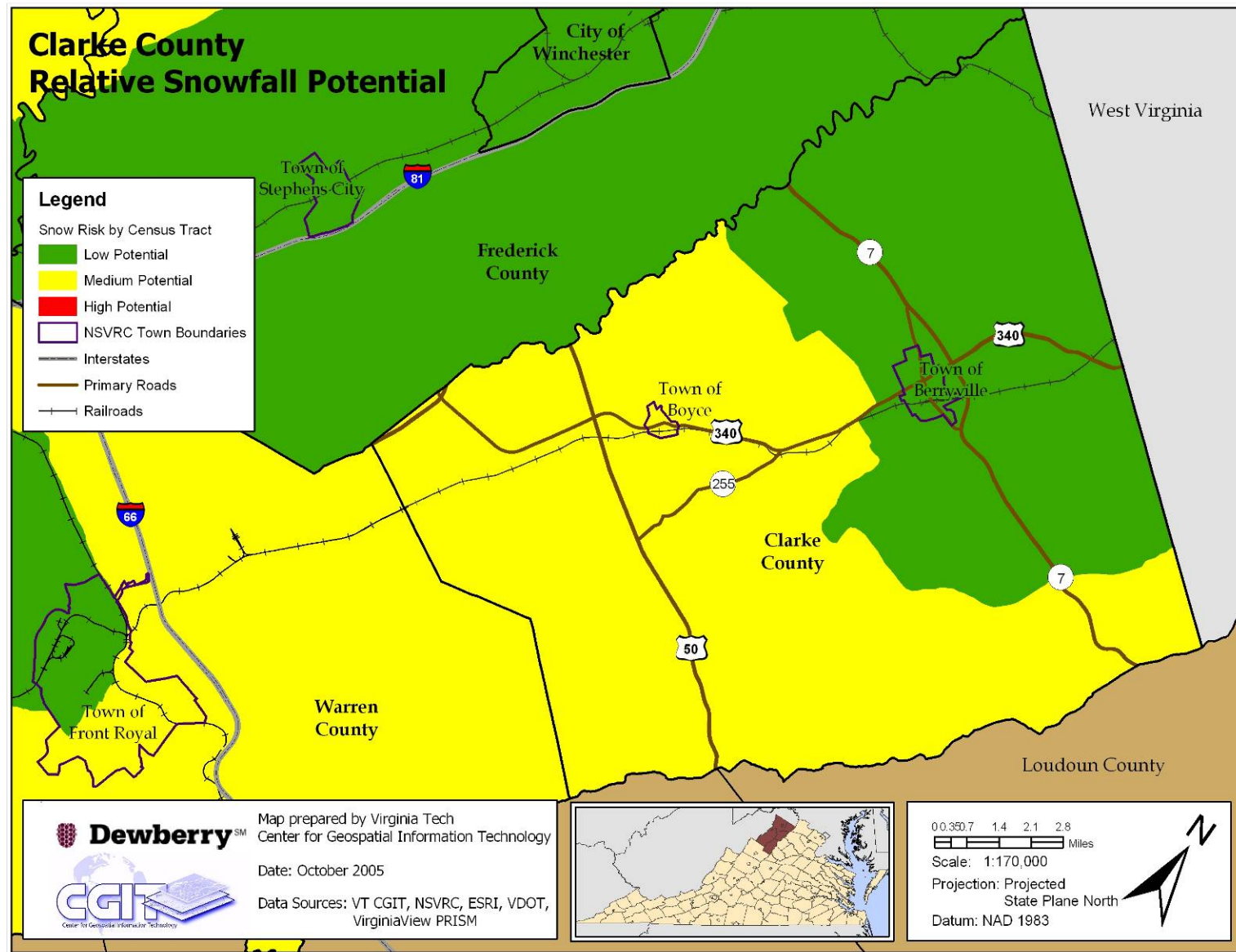
Annualized Flood Damage

Northern Shenandoah Regional Map	D-24
Clarke County	D-25
<i>Town of Berryville</i>	D-26
Frederick County	D-27
<i>Town of Middletown</i>	D-28
<i>Town of Stephens City</i>	D-29
Page County	D-30
<i>Town of Luray</i>	D-31
<i>Town of Stanley</i>	D-32
<i>Town of Shenandoah</i>	D-33
Shenandoah County	D-34
<i>Town of Edinburg</i>	D-35
<i>Town of Mount Jackson</i>	D-36
<i>Town of Strasburg</i>	D-37
<i>Town of Toms Brook</i>	D-38
<i>Town of Woodstock</i>	D-39
Warren County	D-40
<i>Town of Front Royal</i>	D-41
City of Winchester	D-42

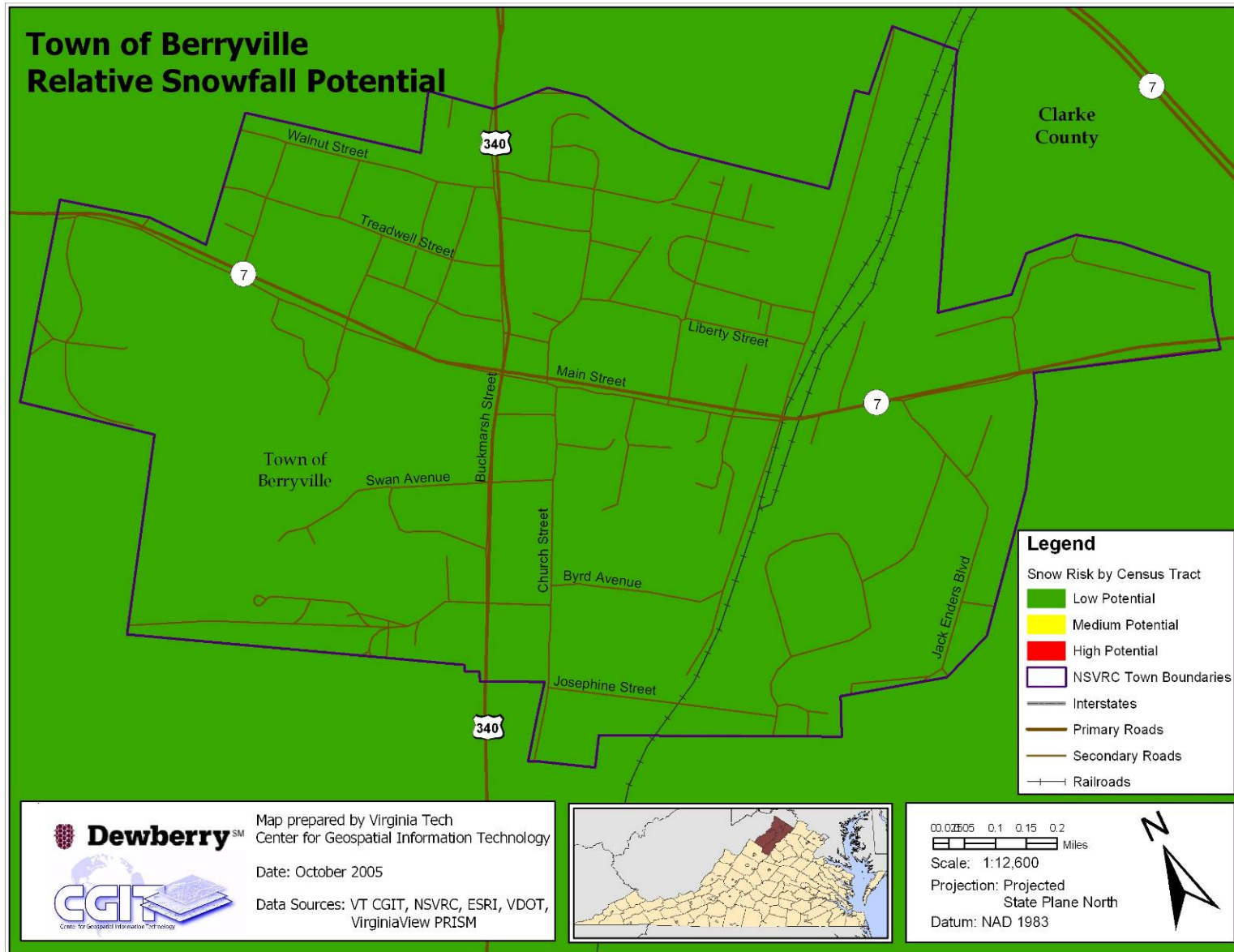
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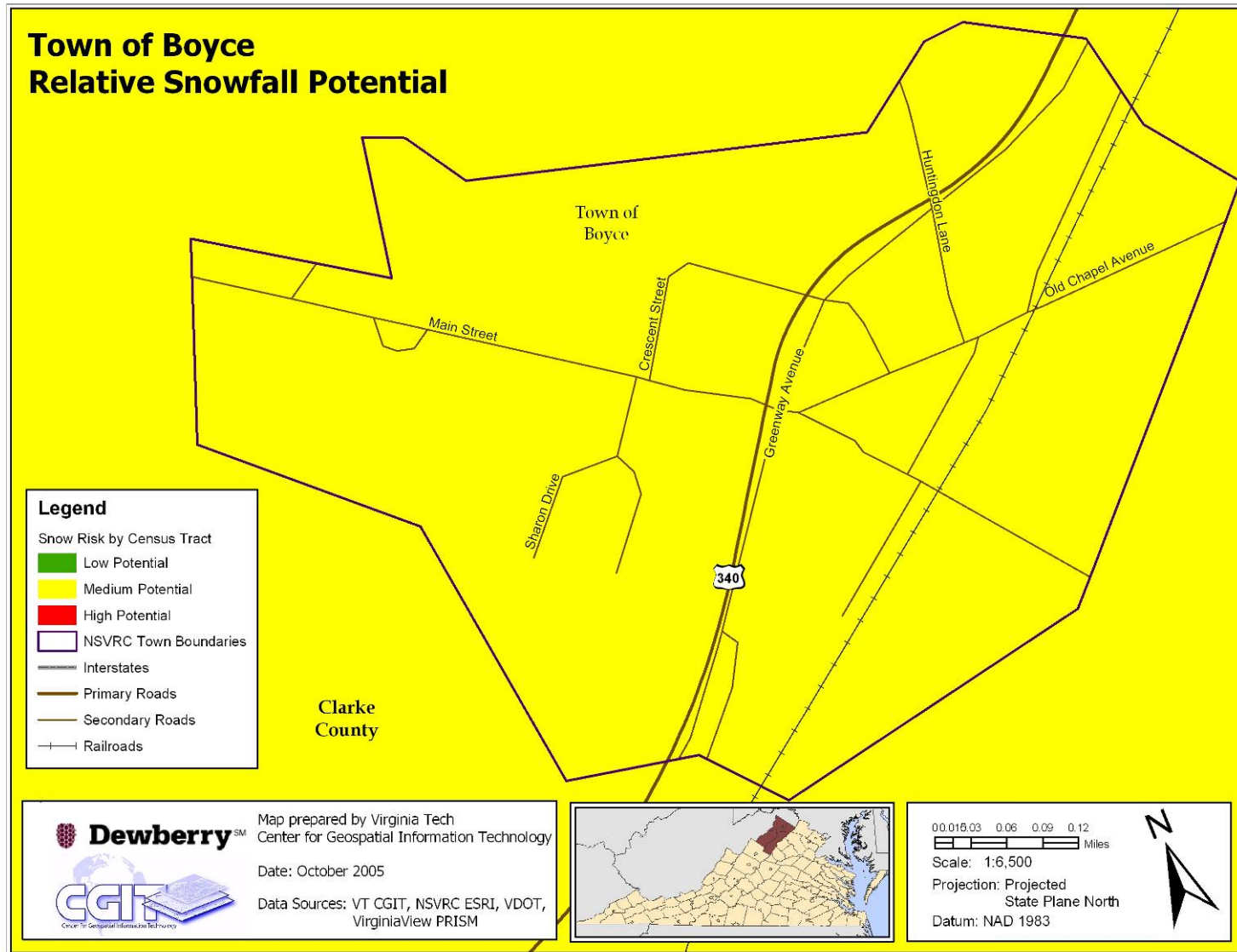
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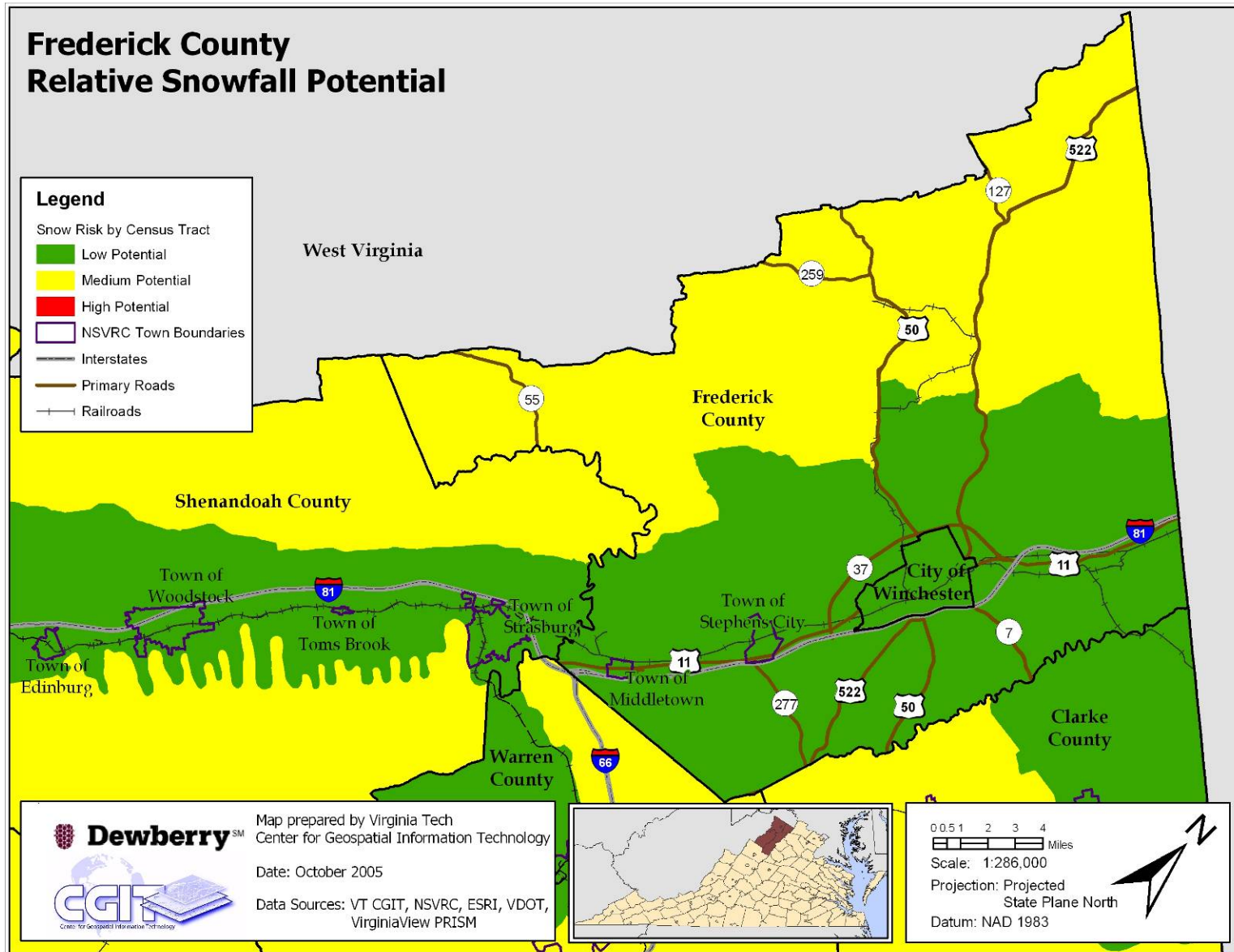
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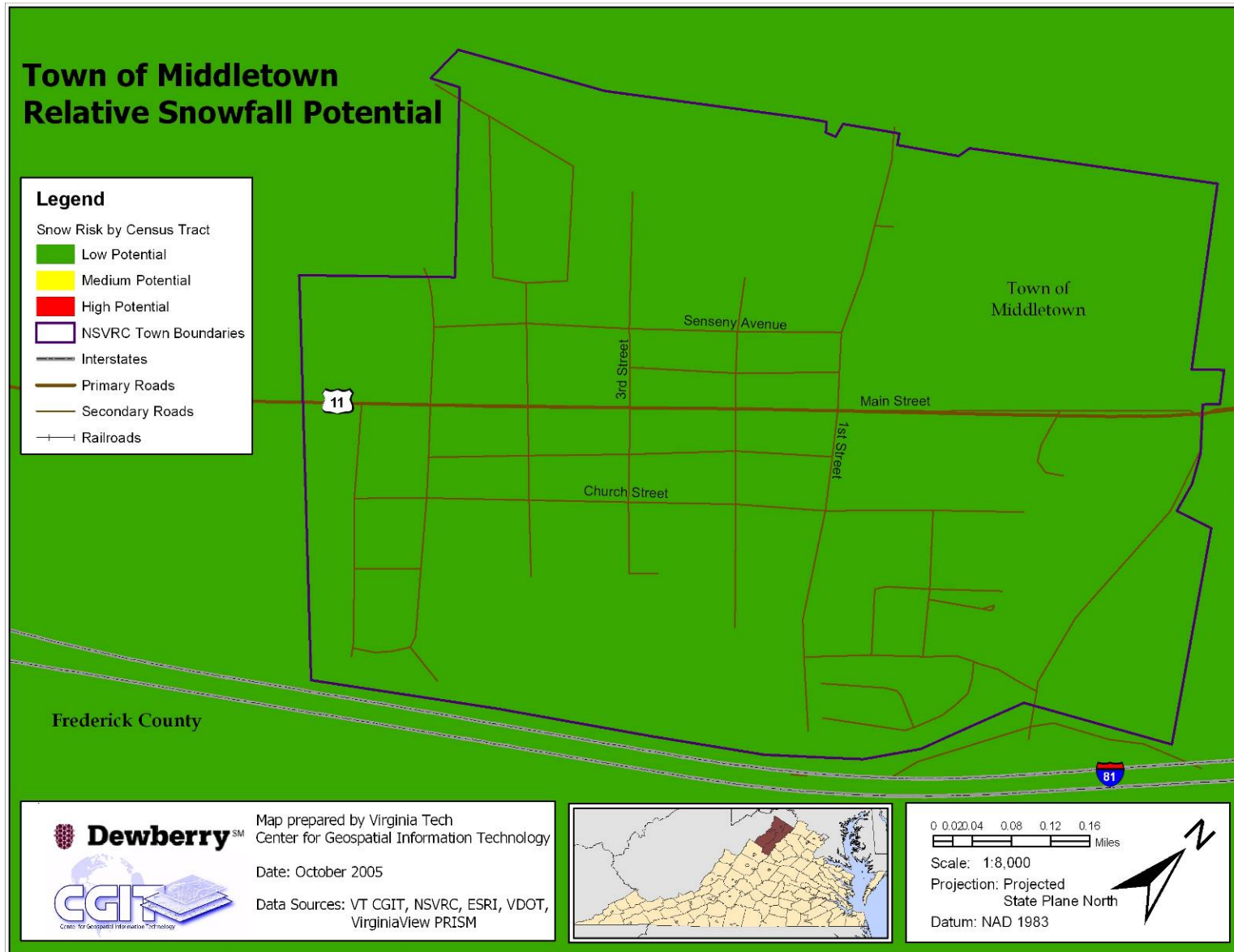
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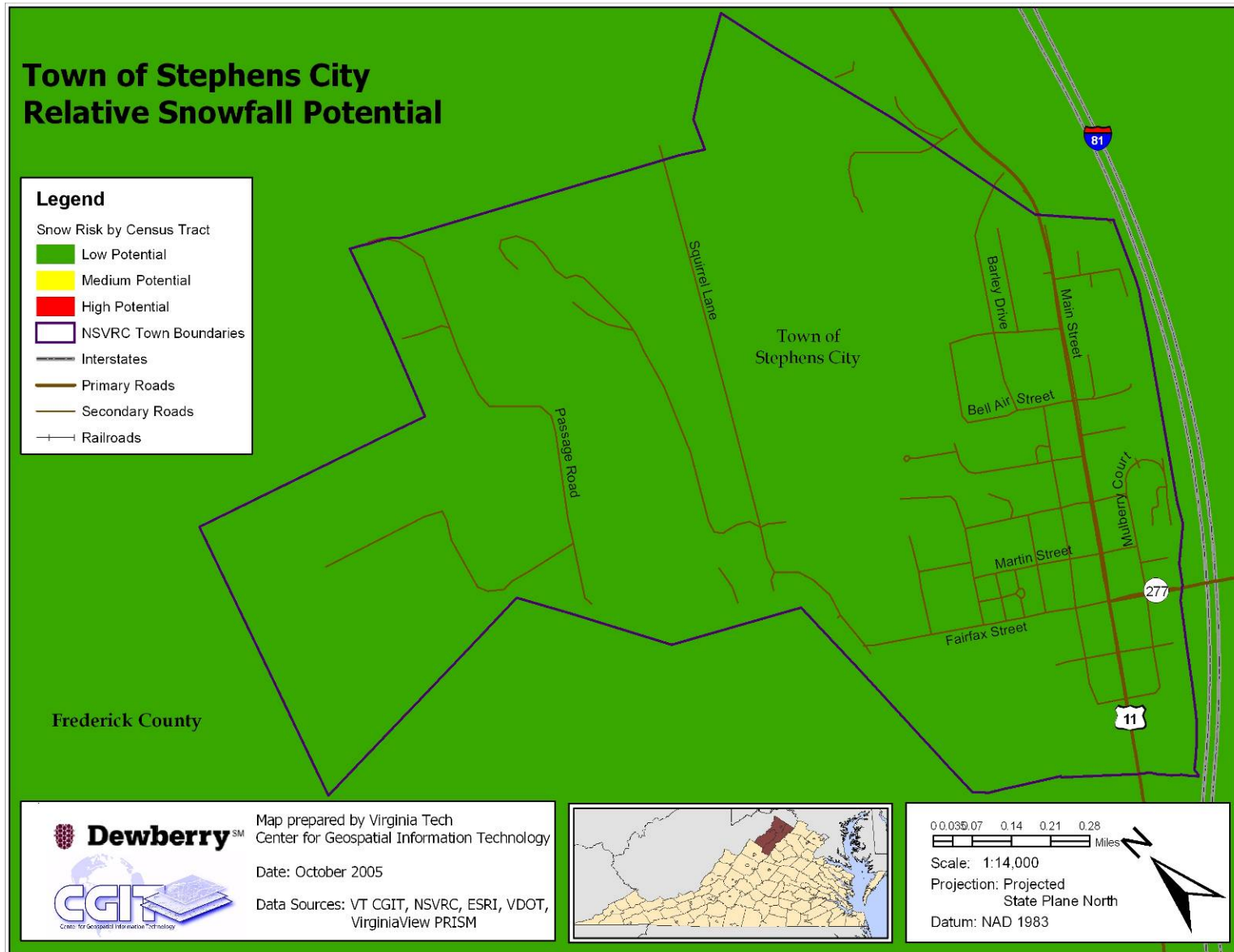
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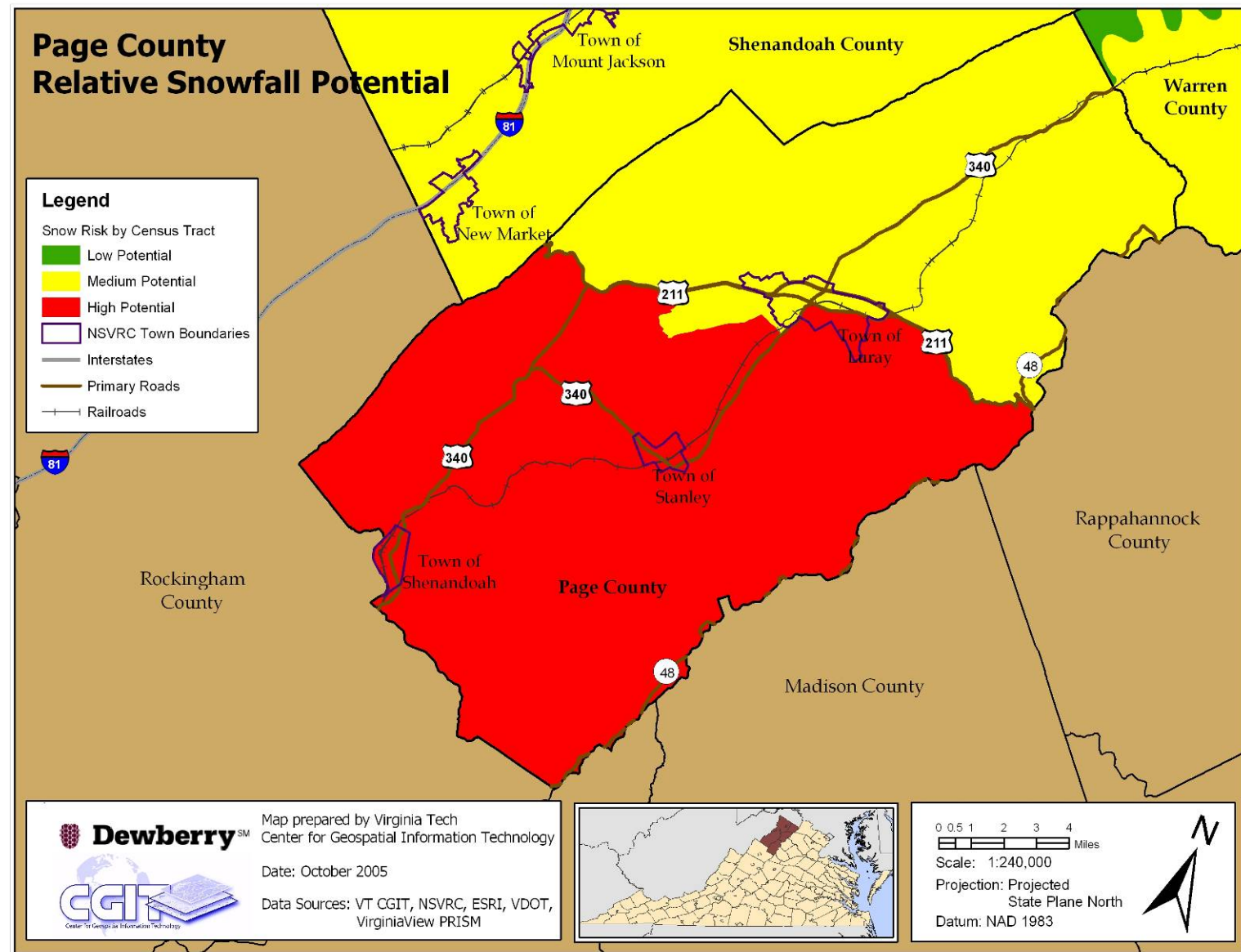
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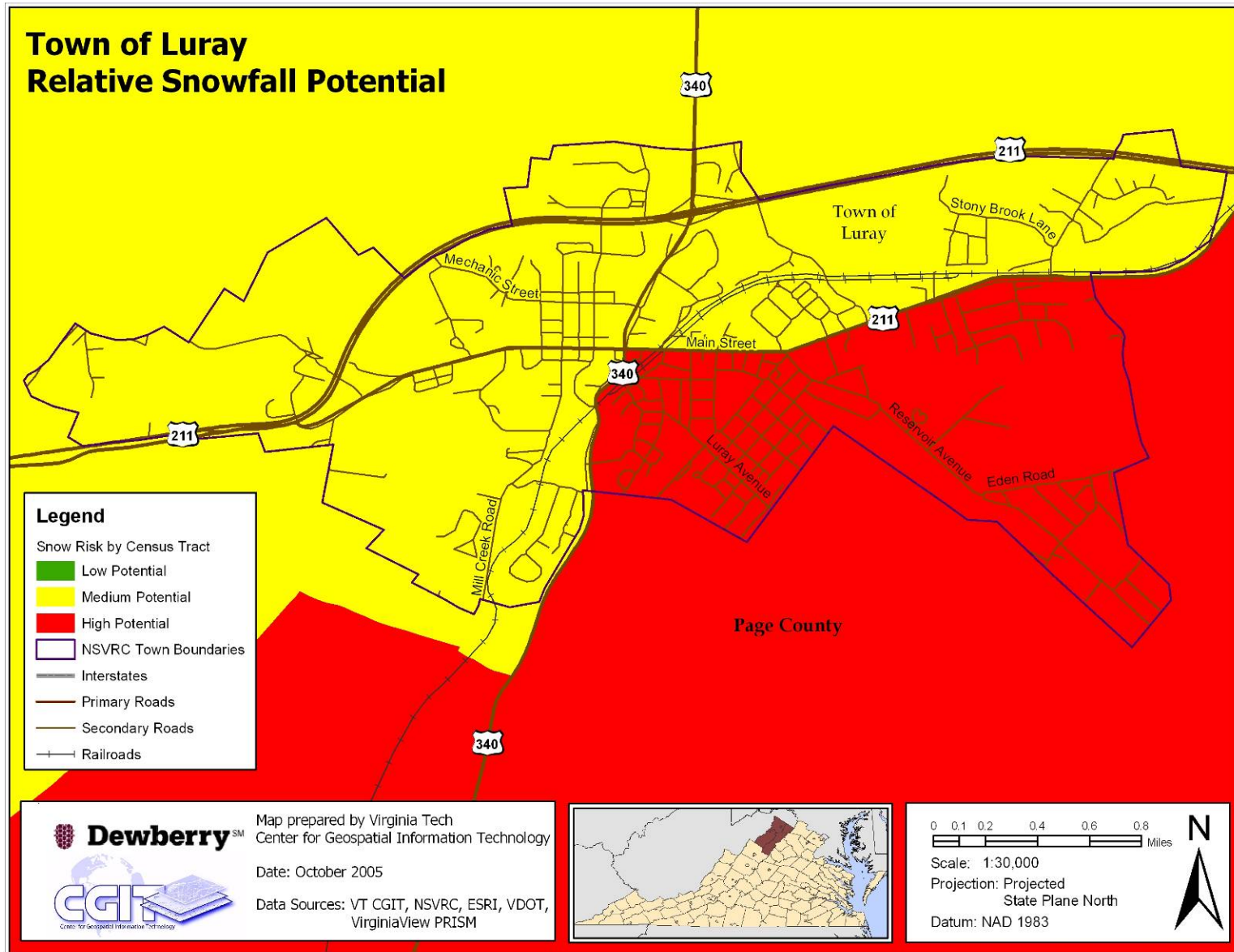
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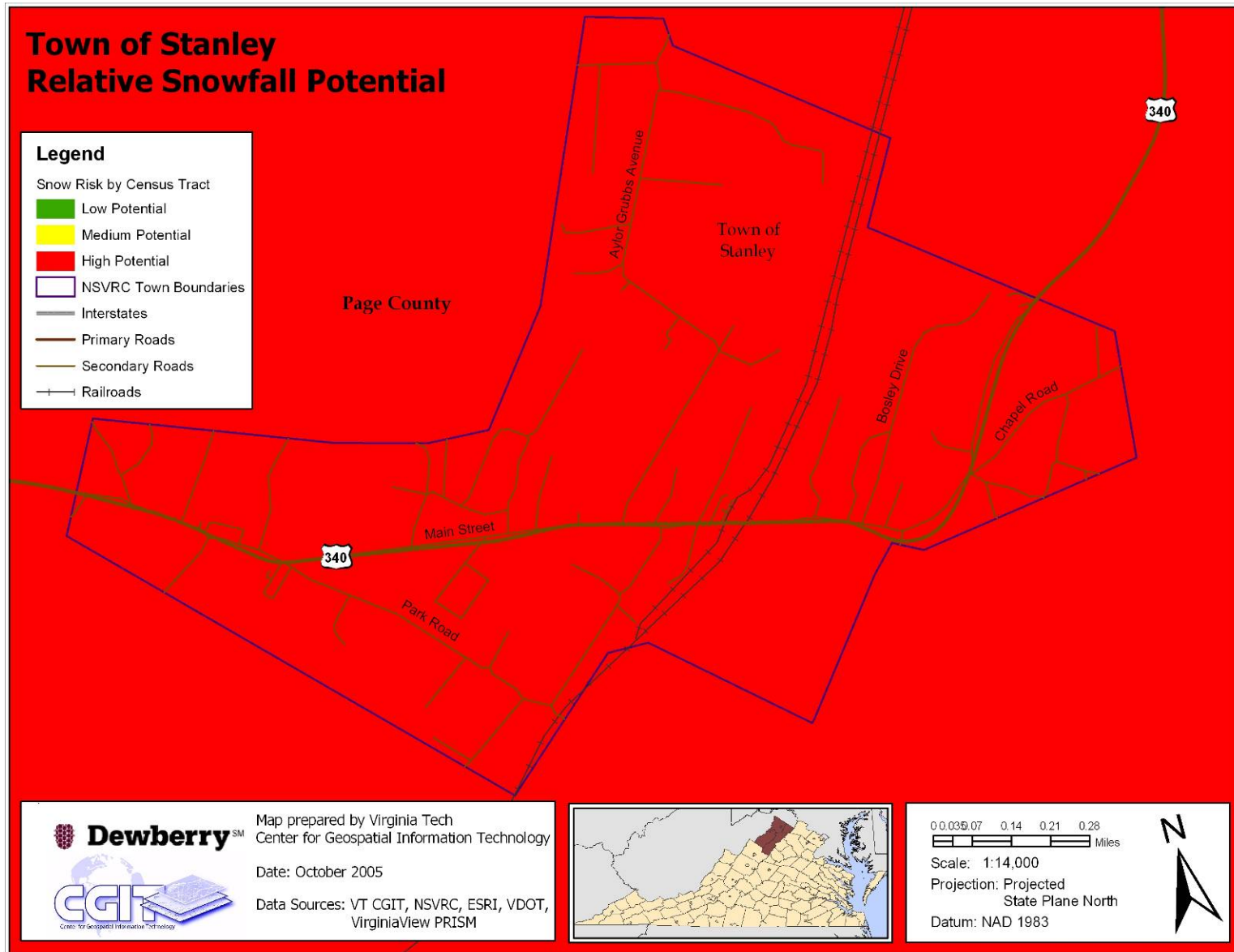
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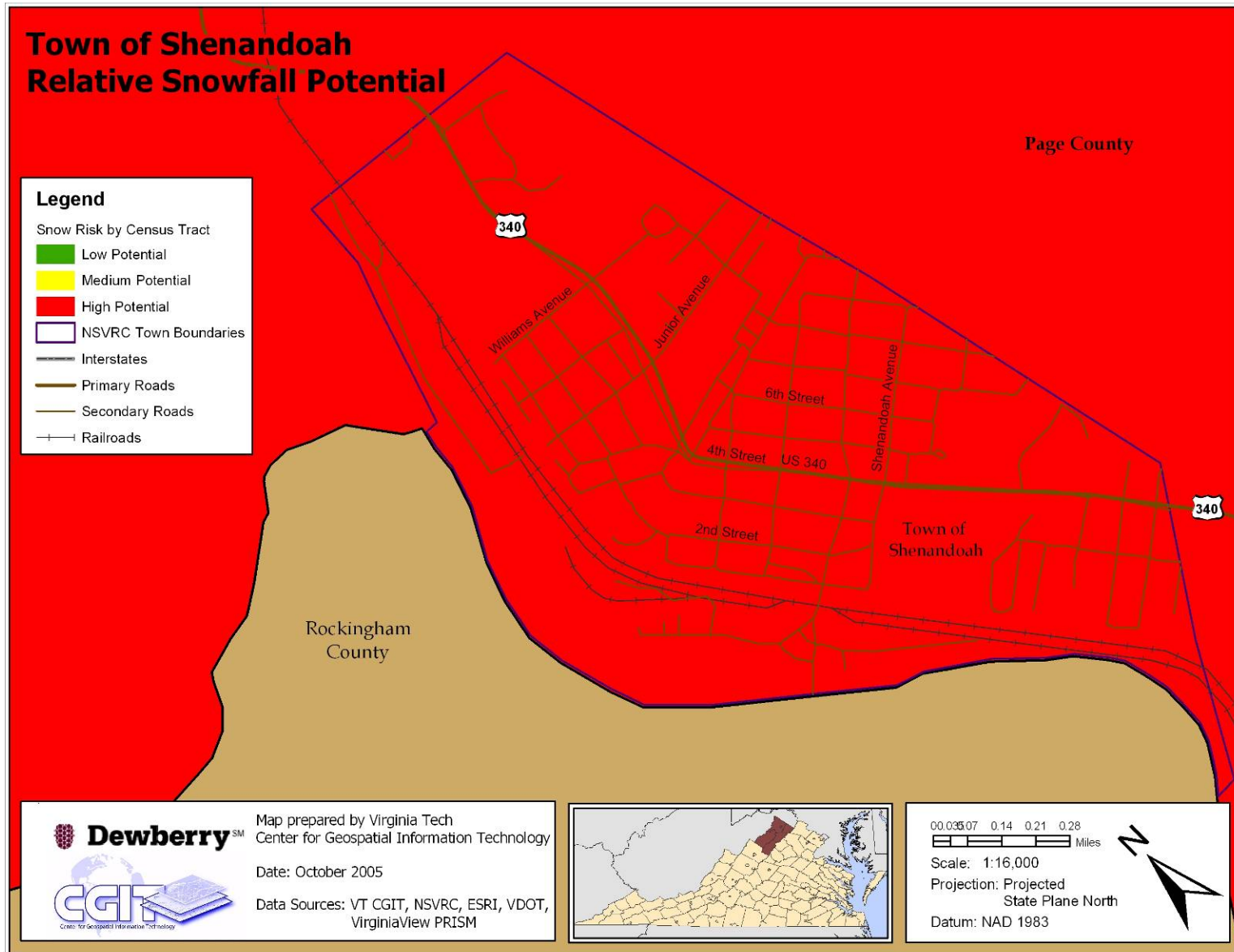
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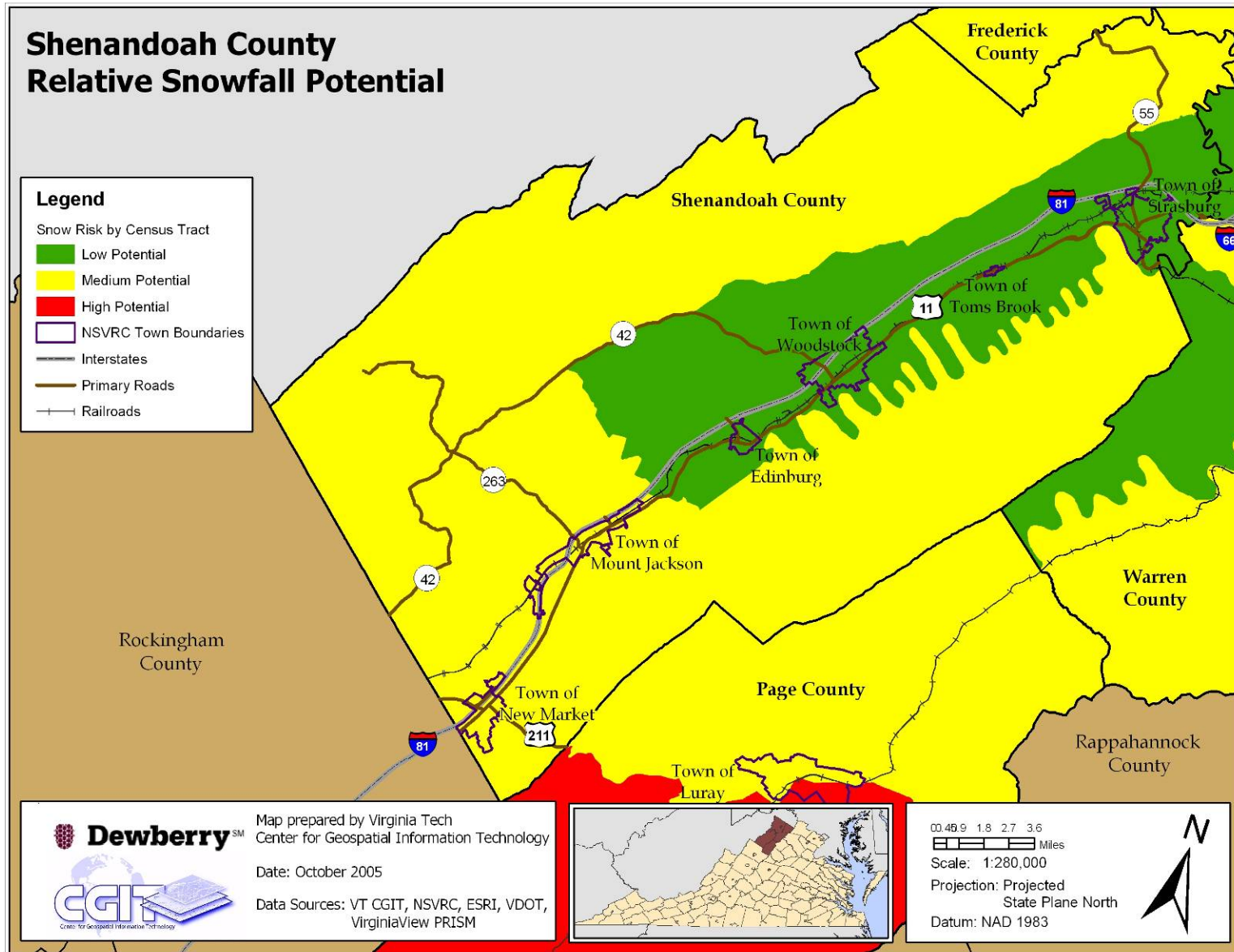
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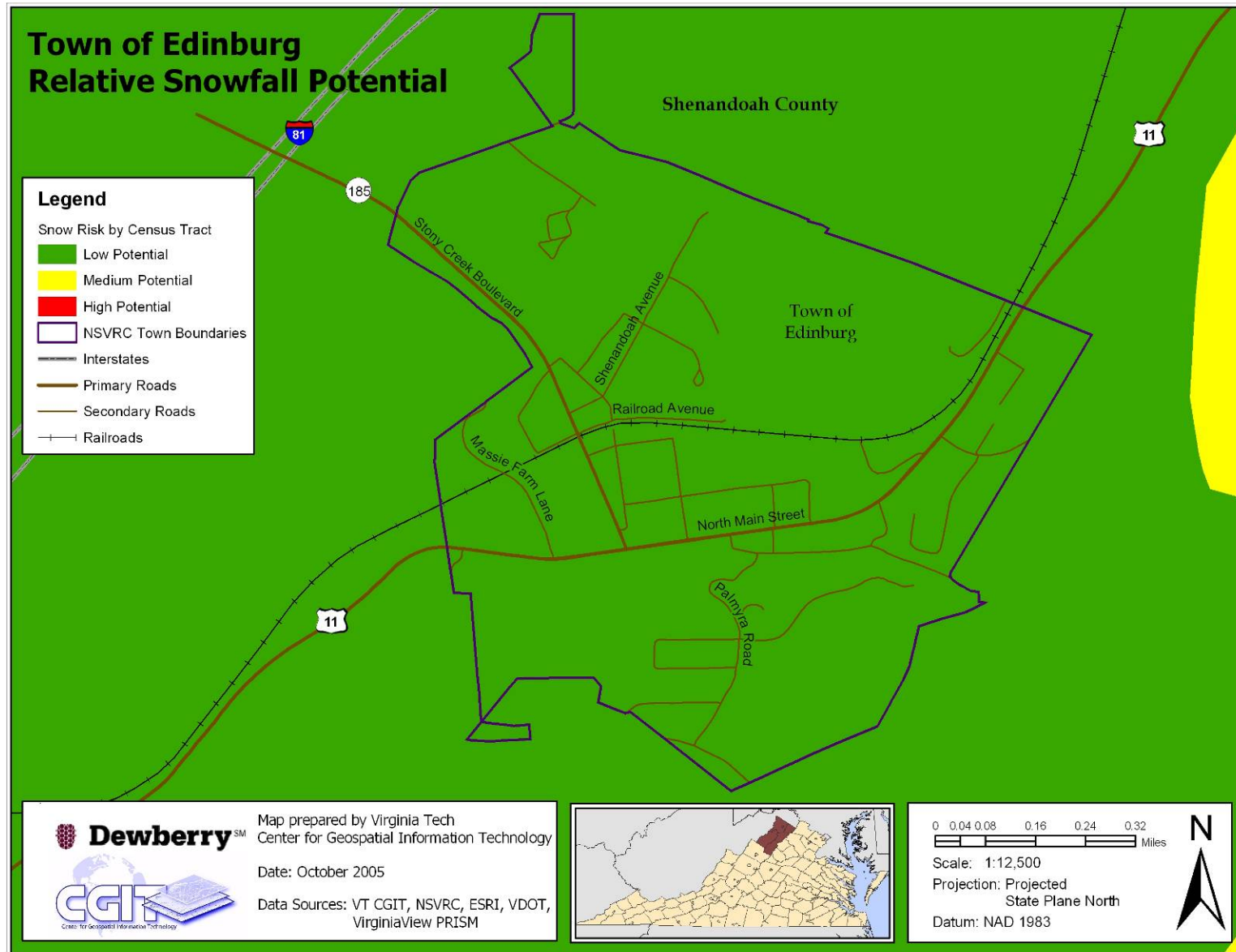
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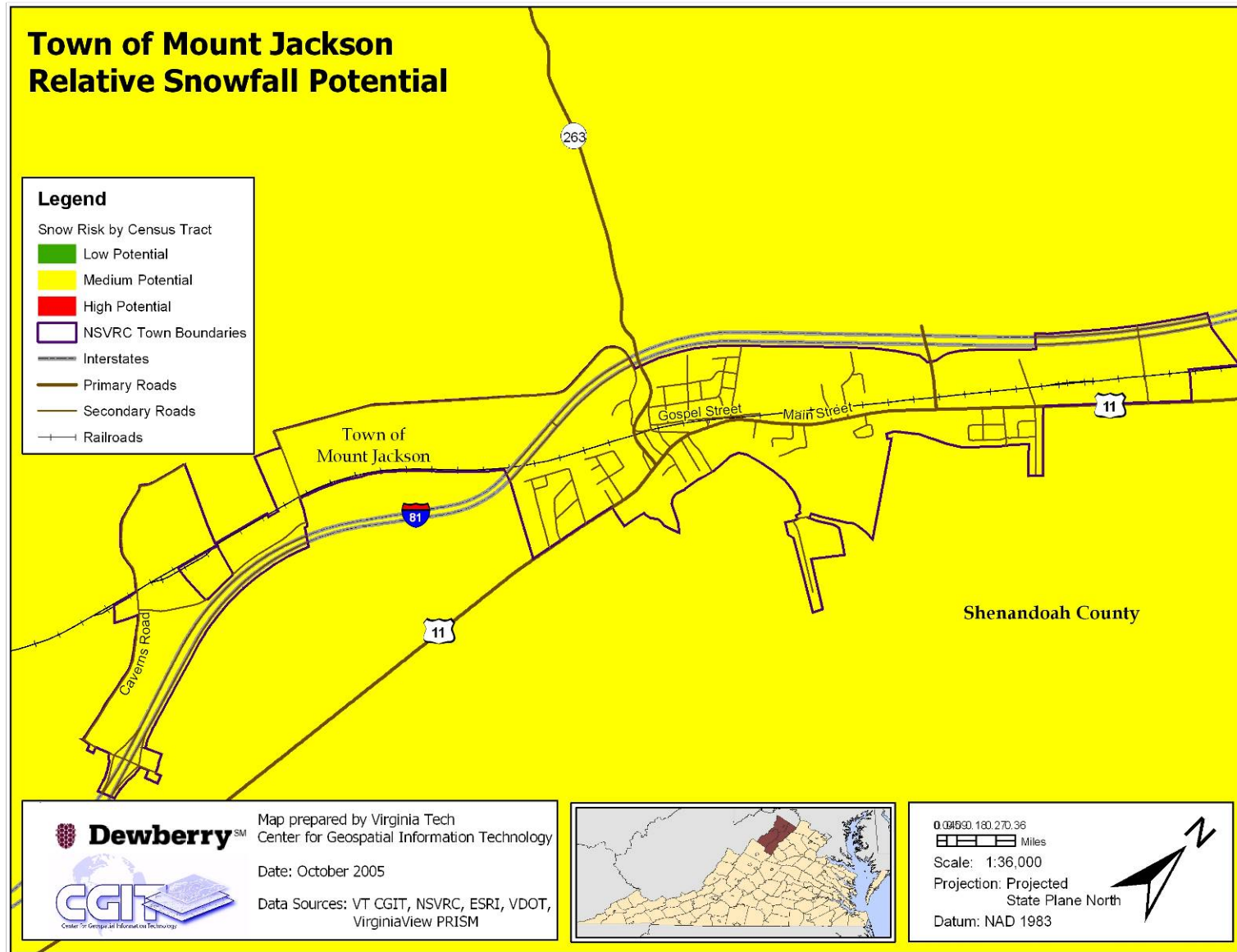
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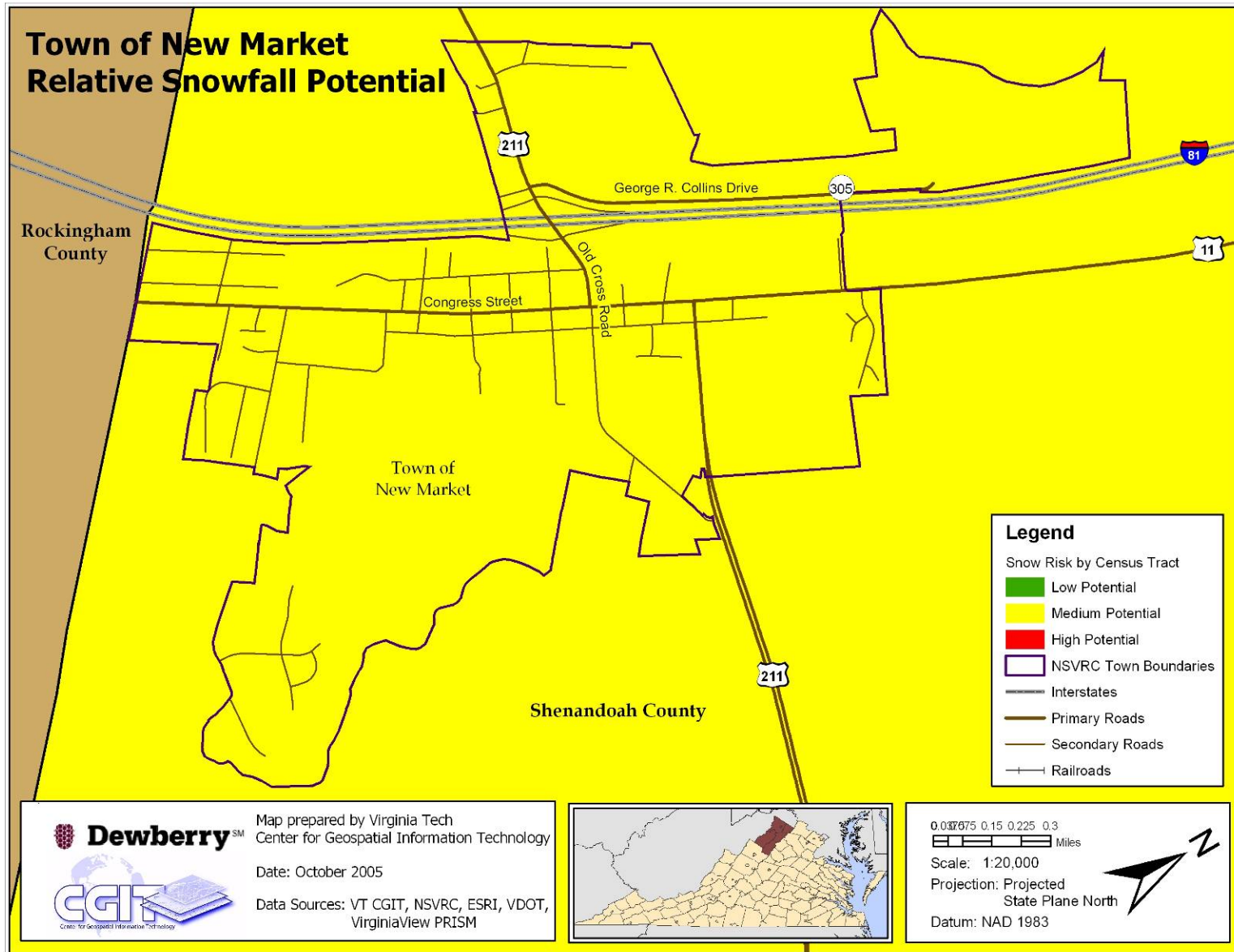
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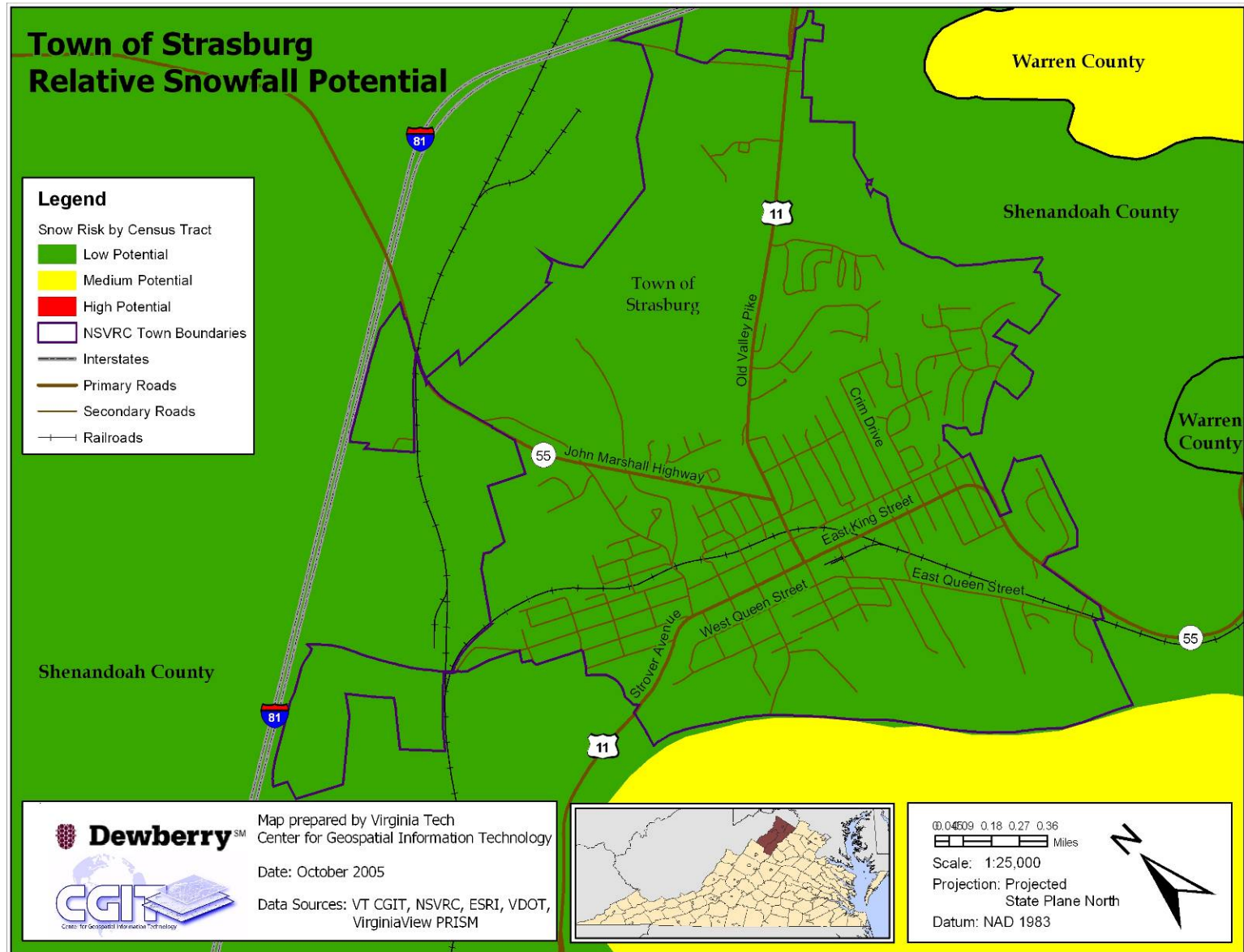
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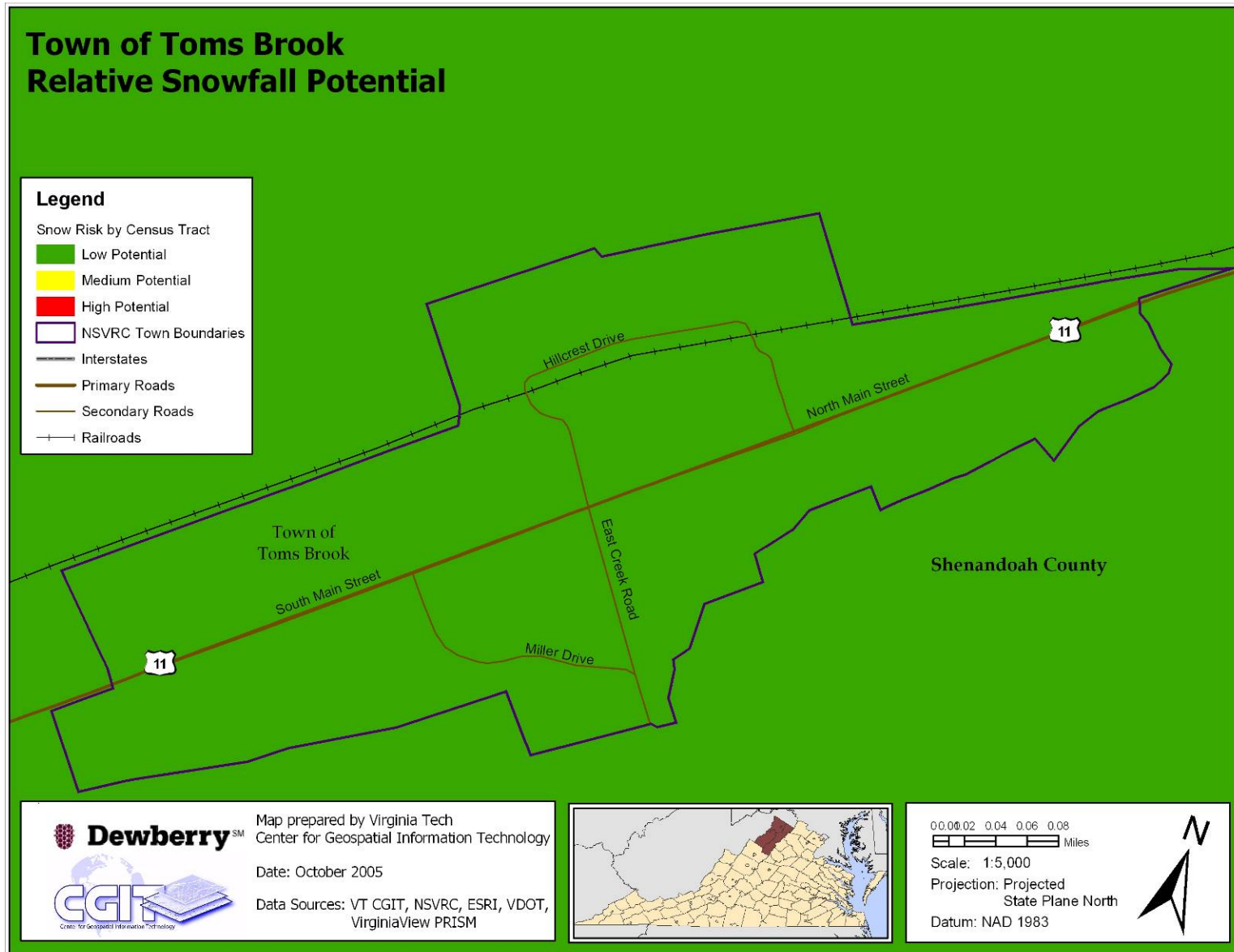
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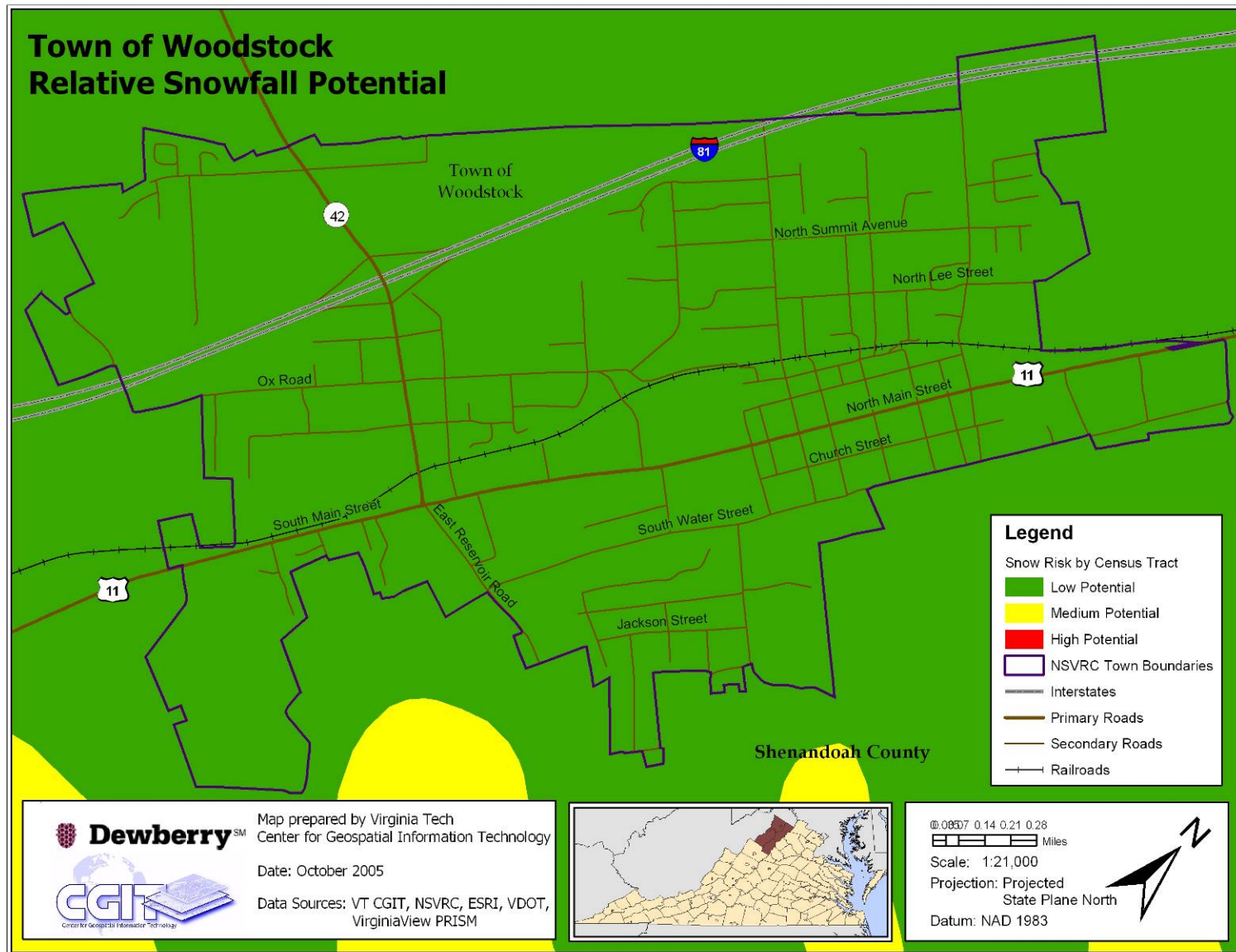
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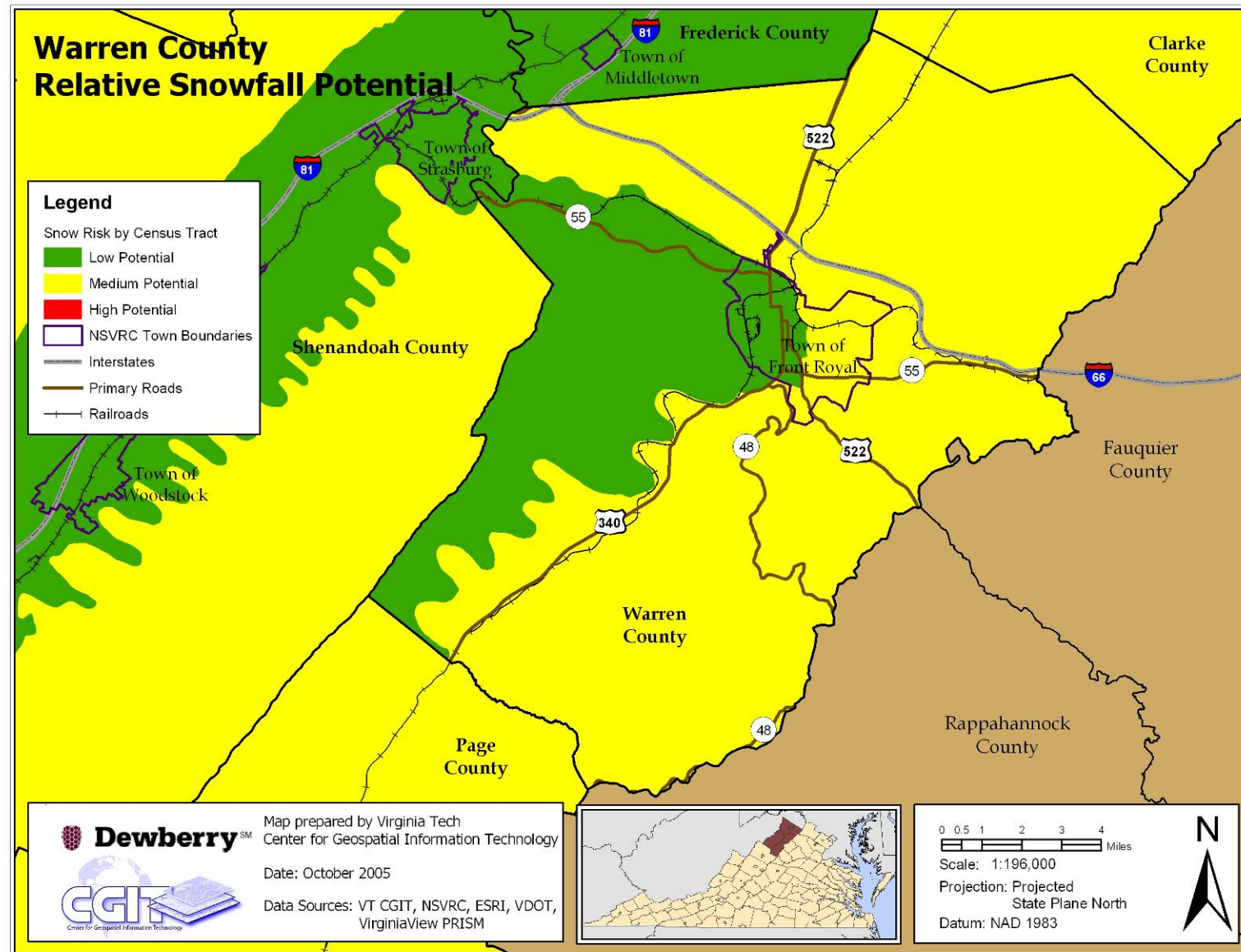
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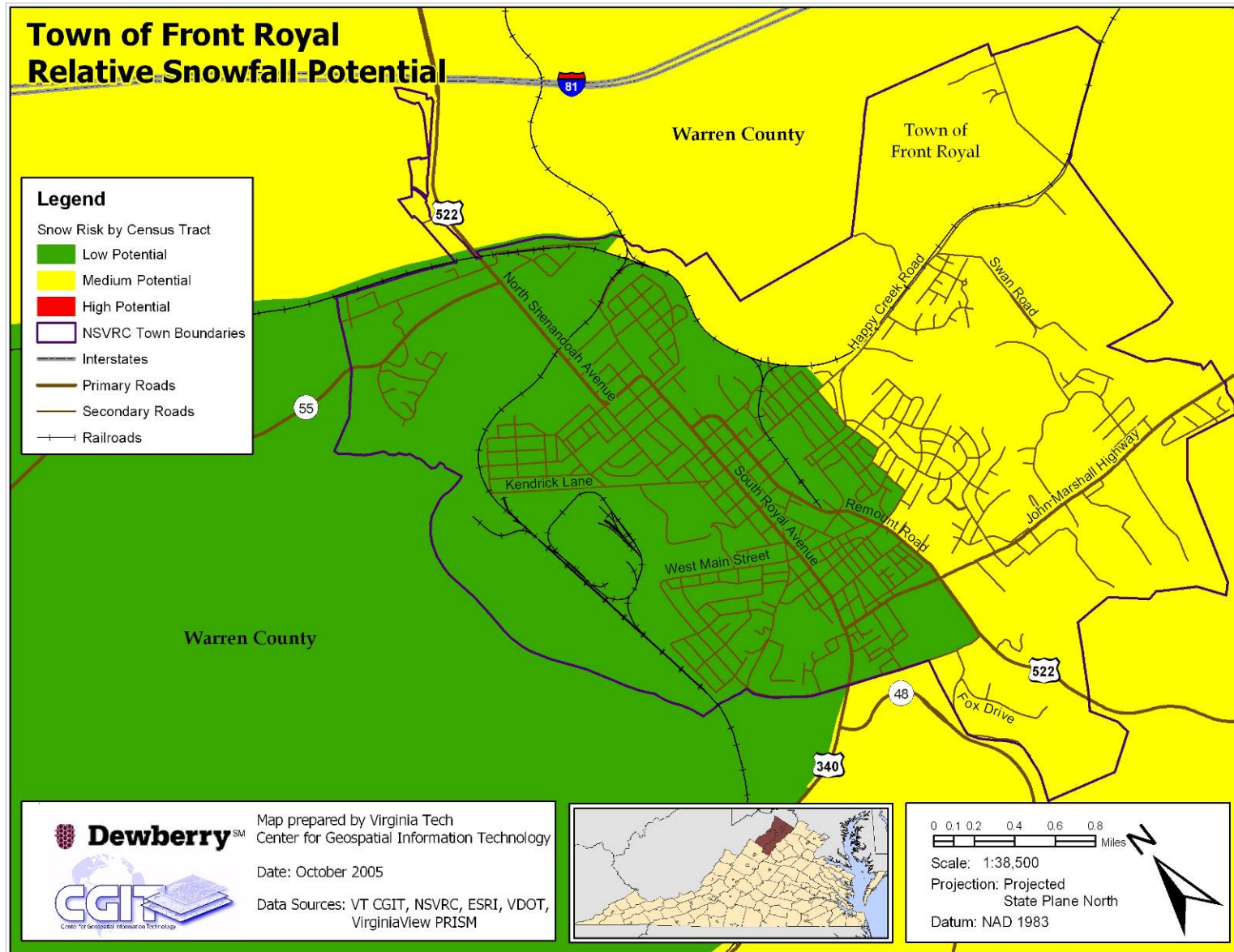
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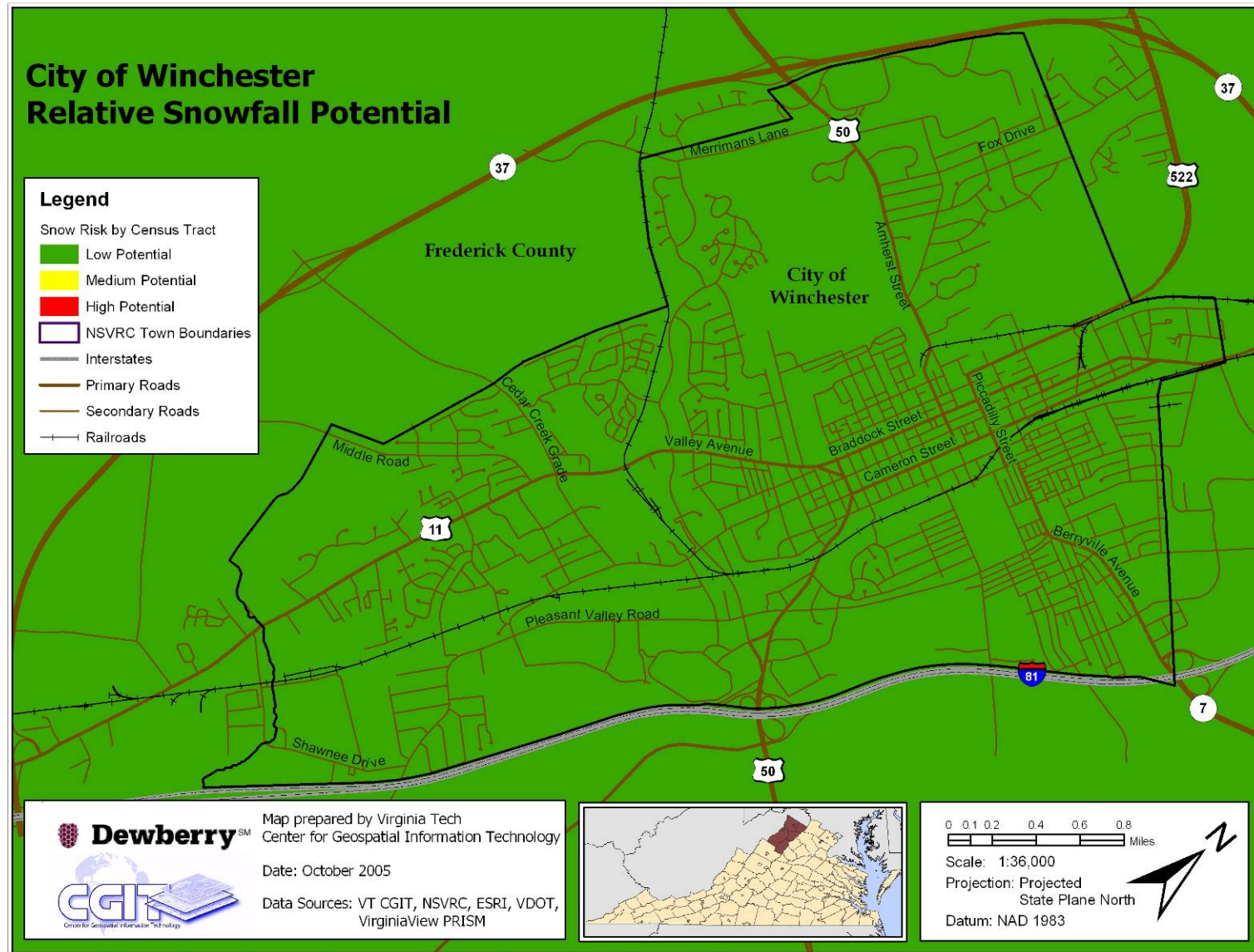
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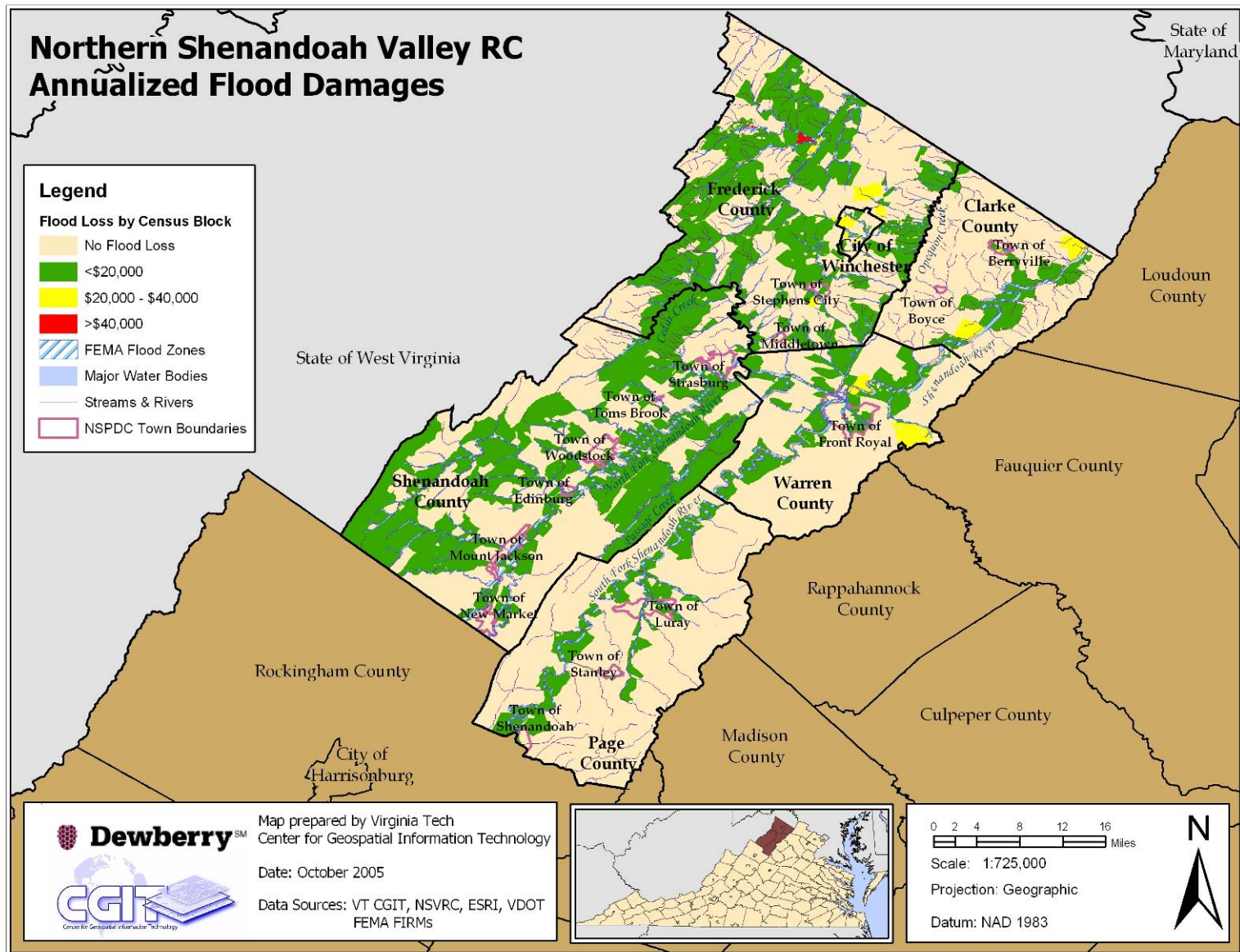
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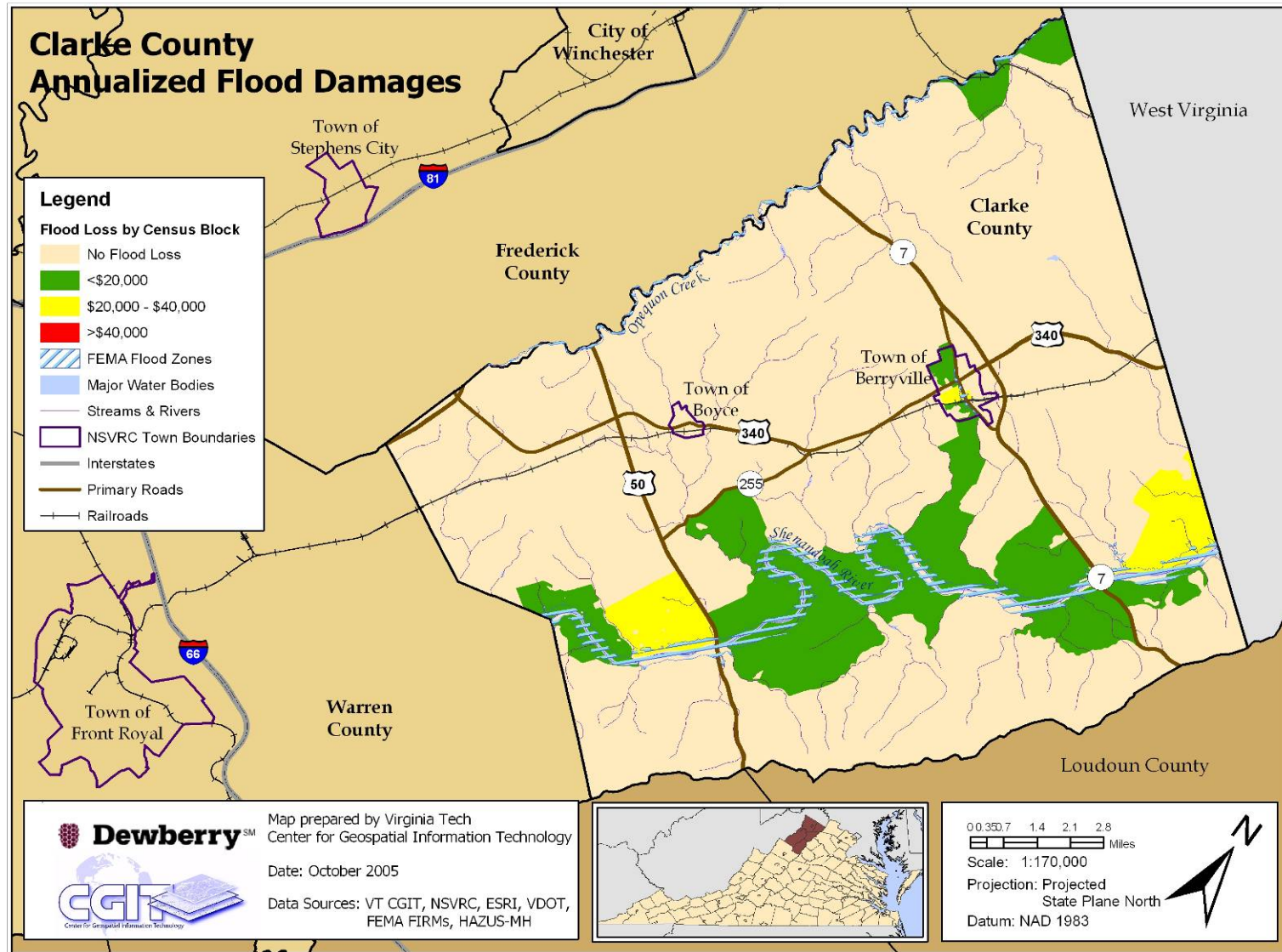
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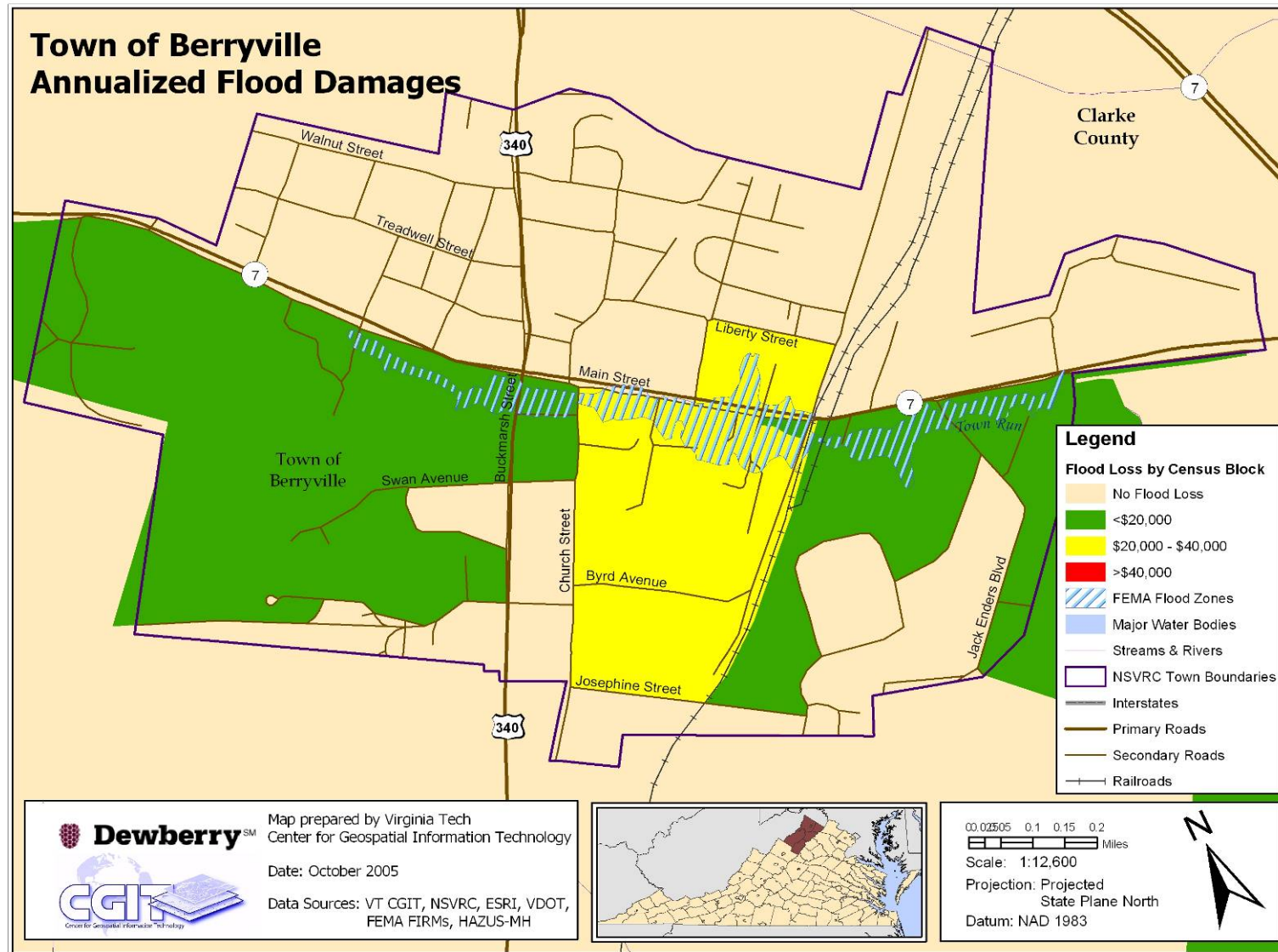
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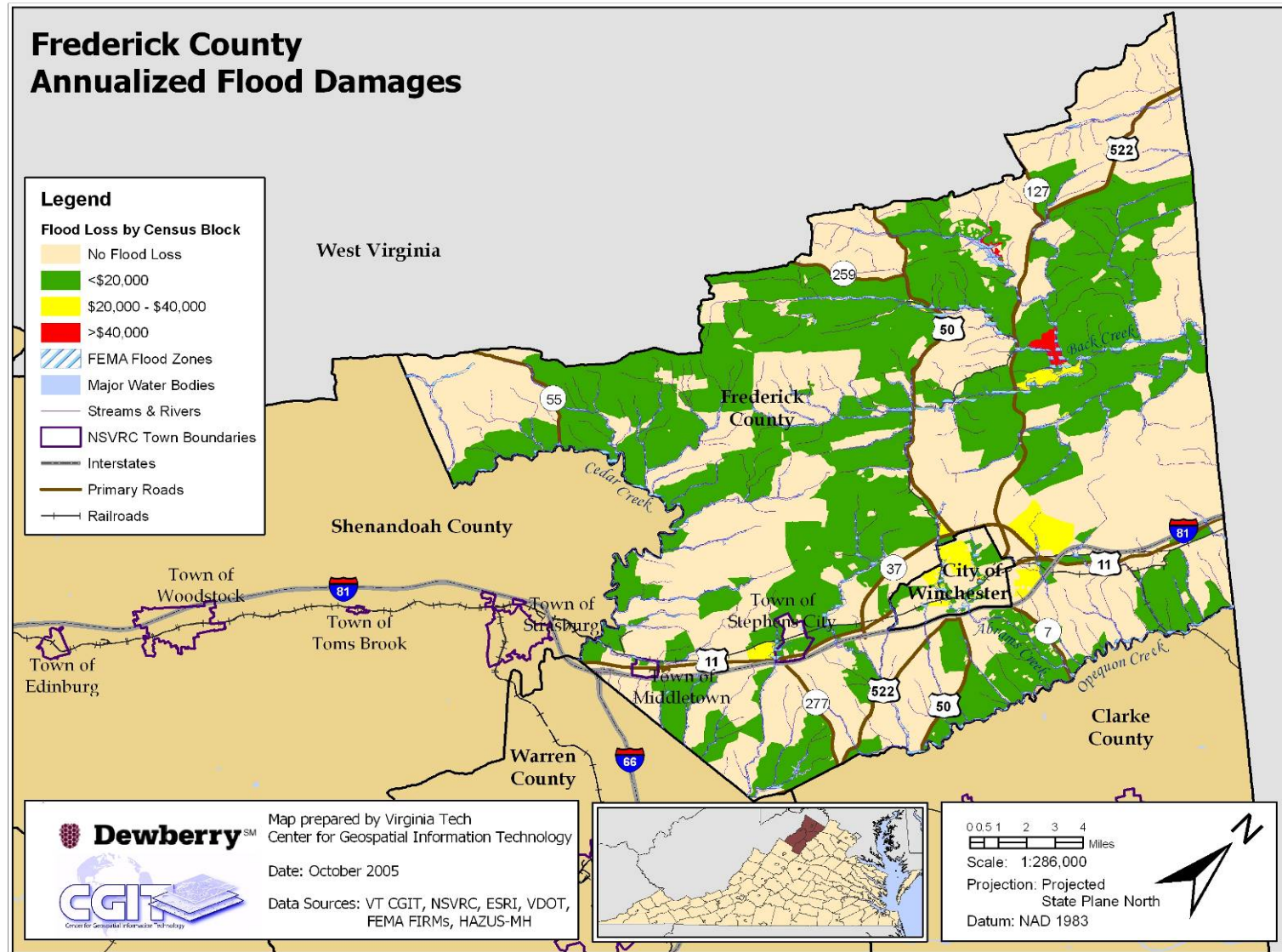
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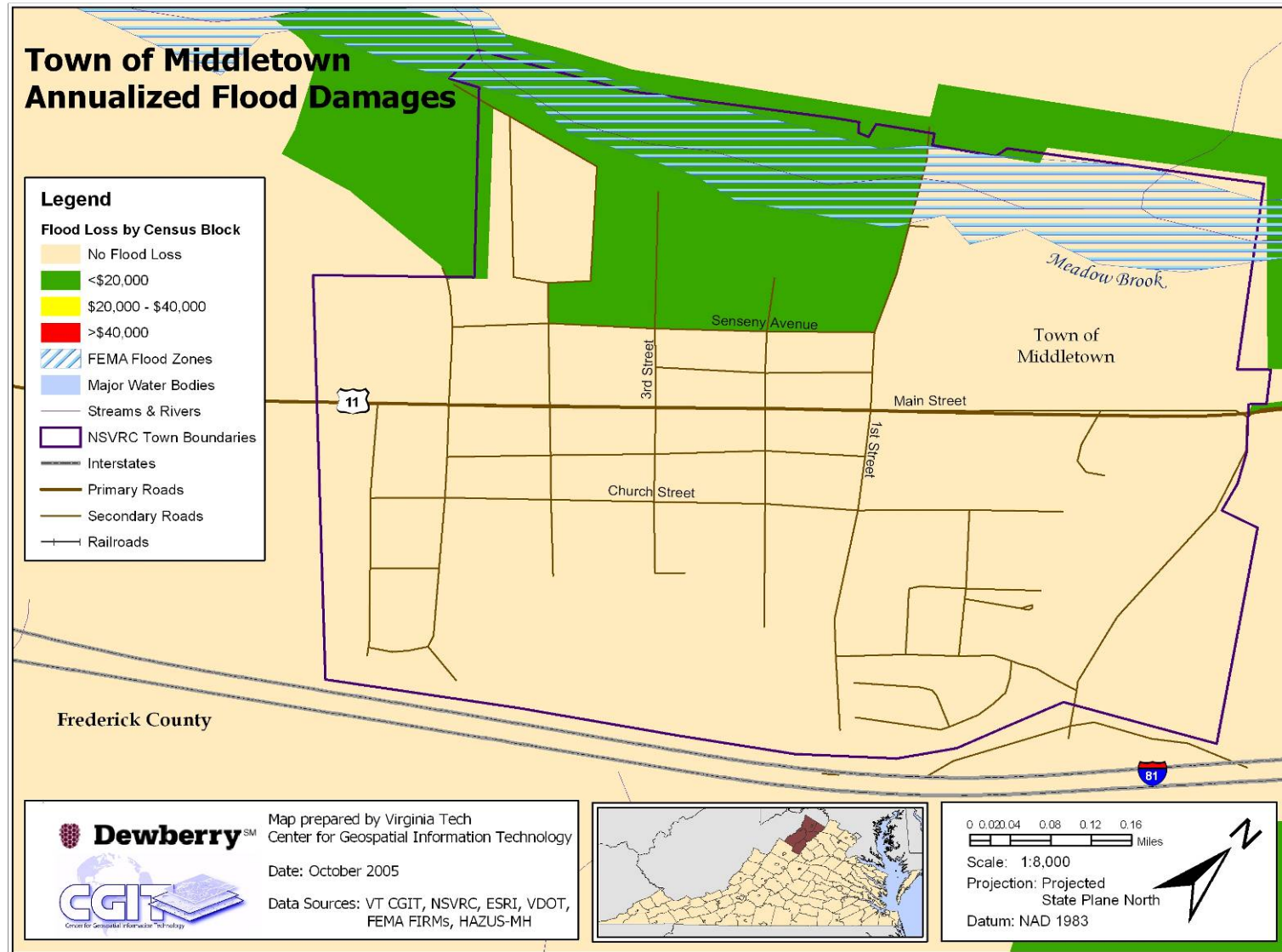
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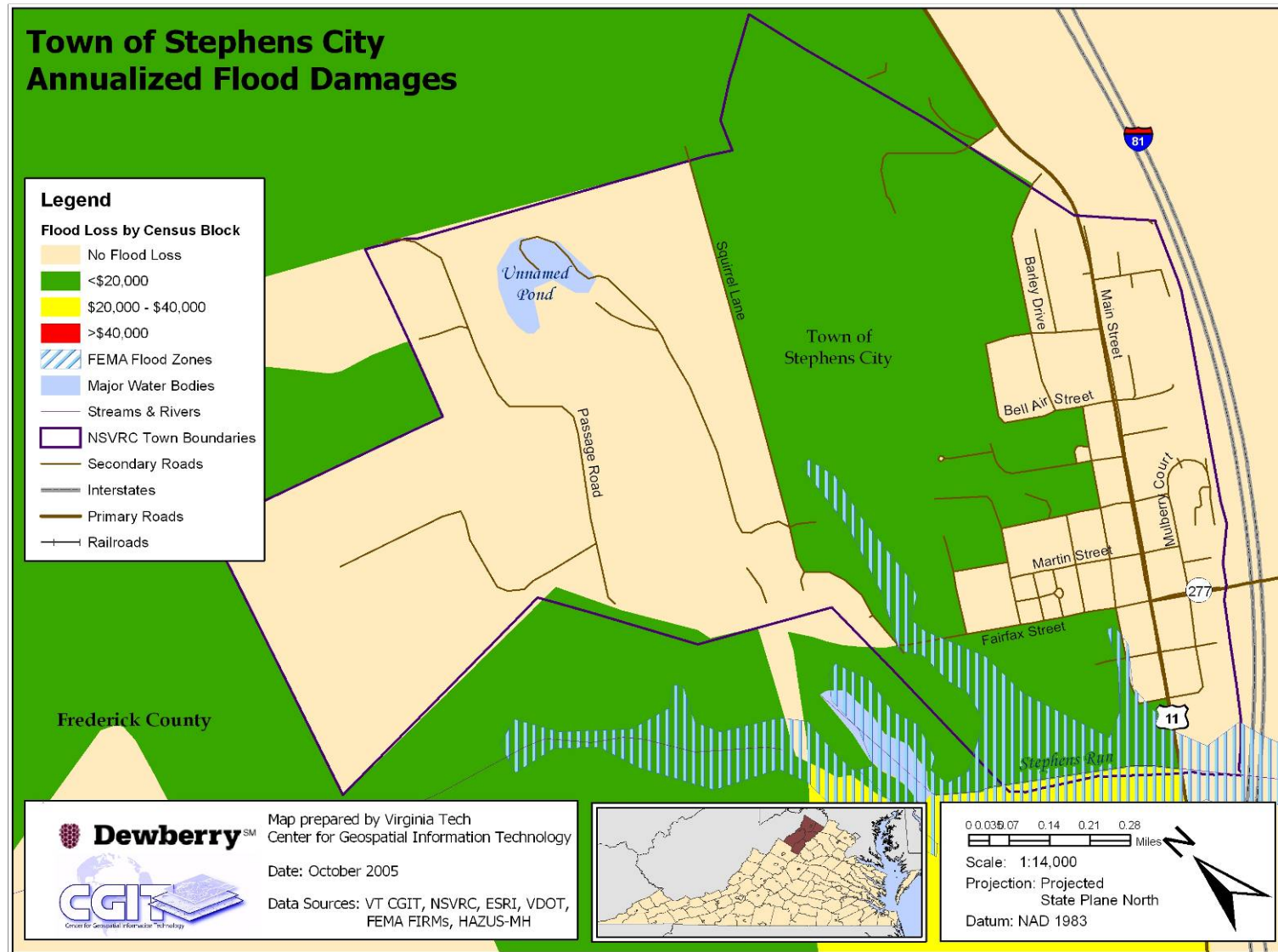
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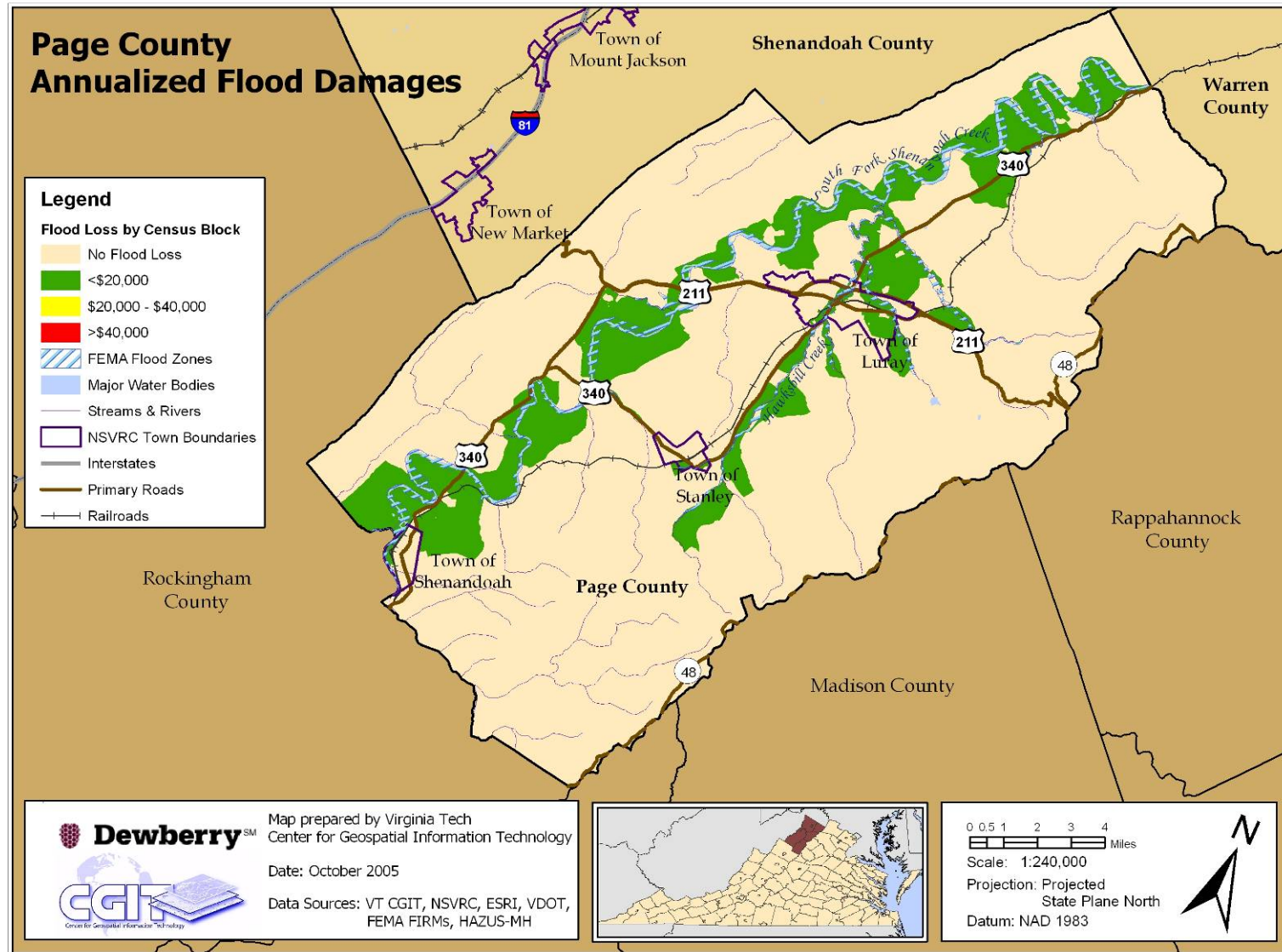
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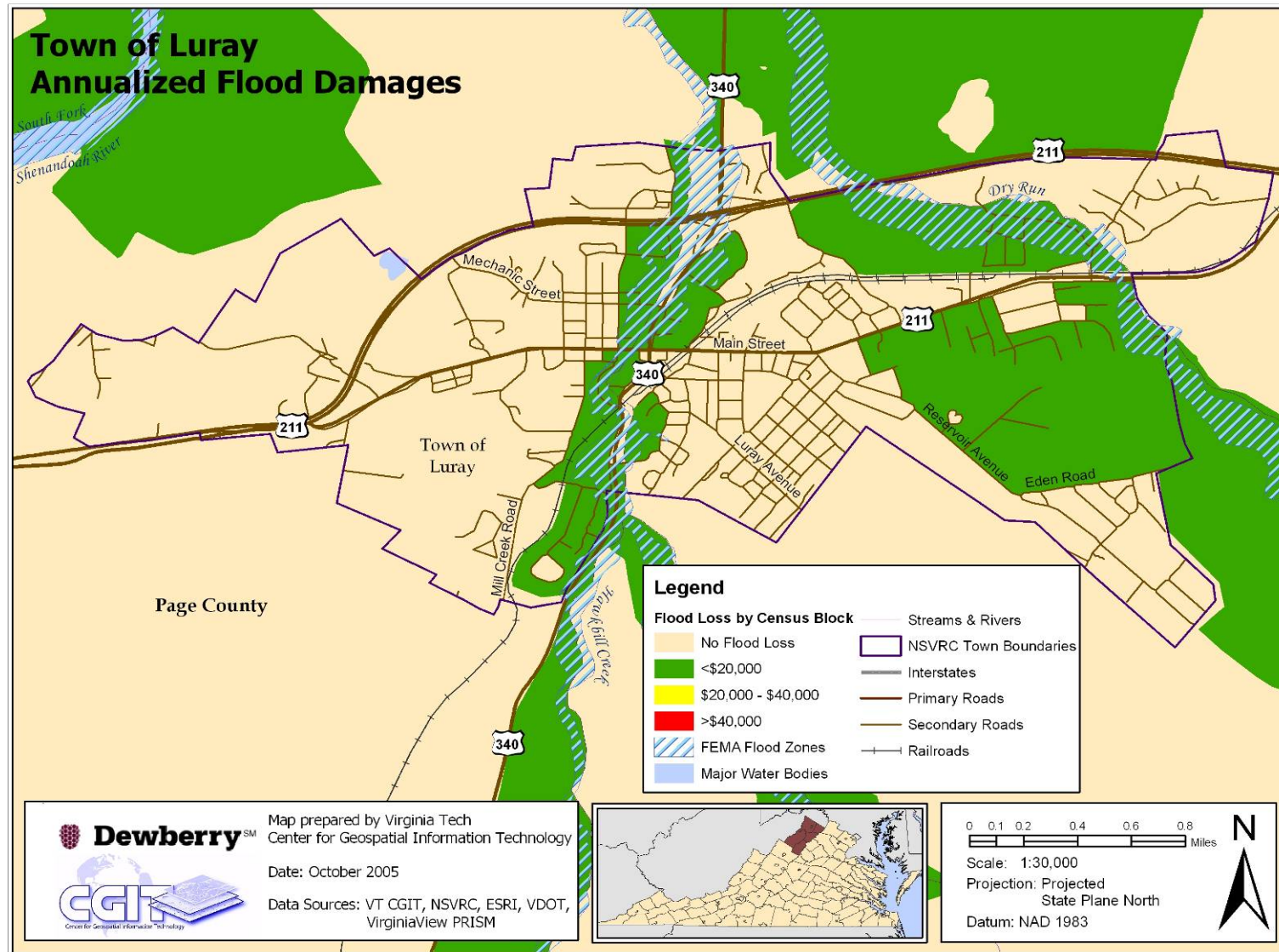
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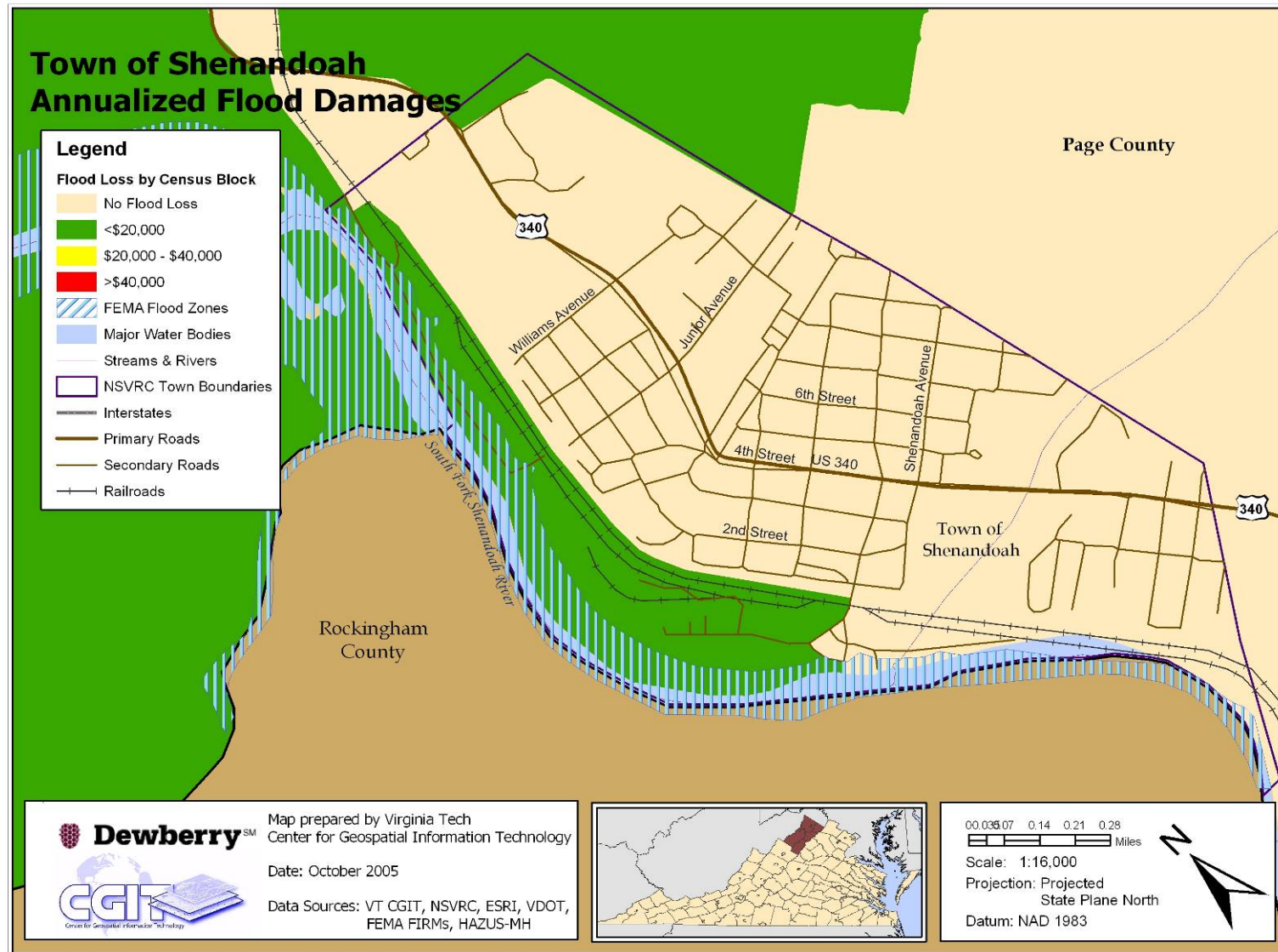
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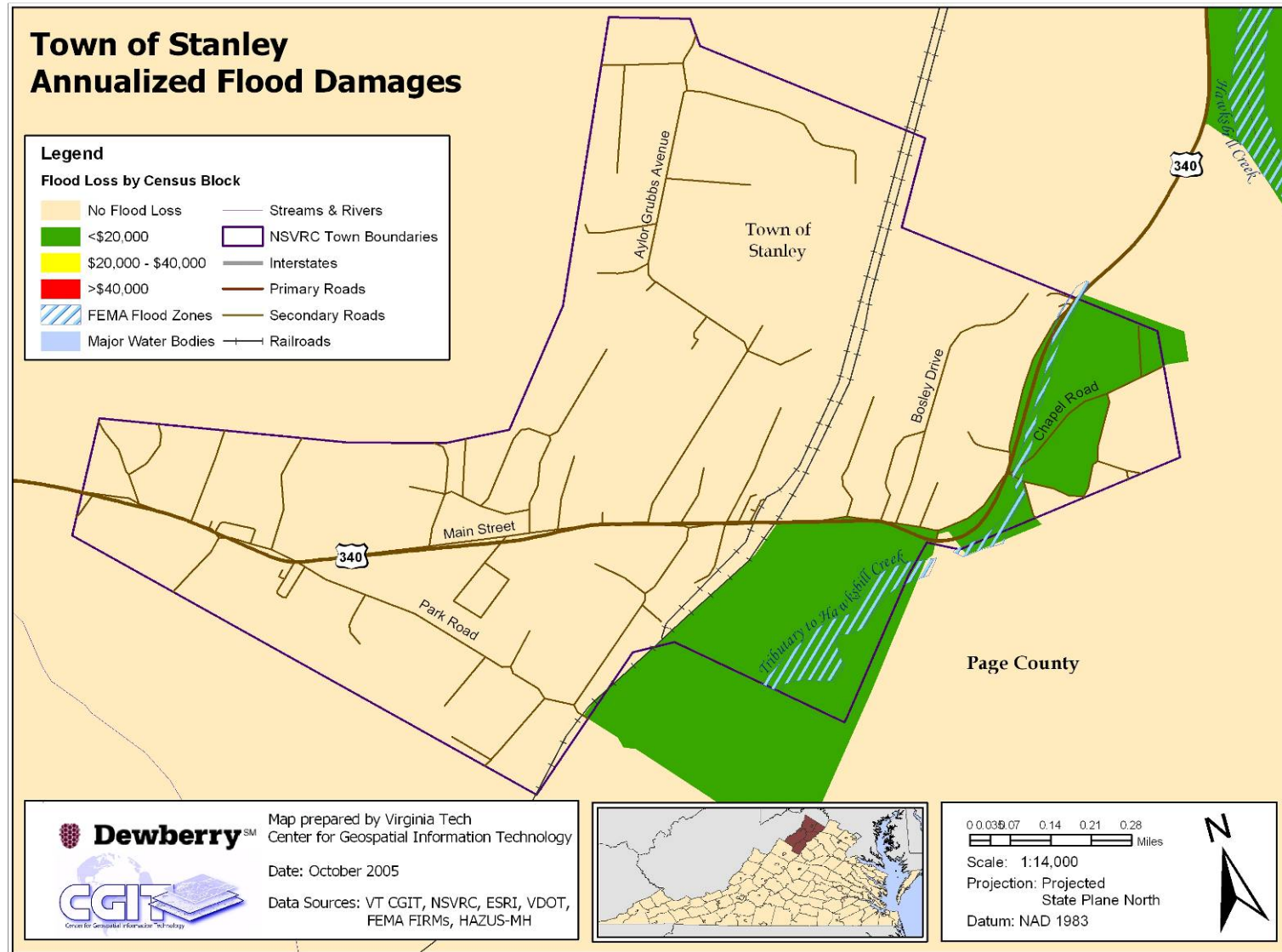
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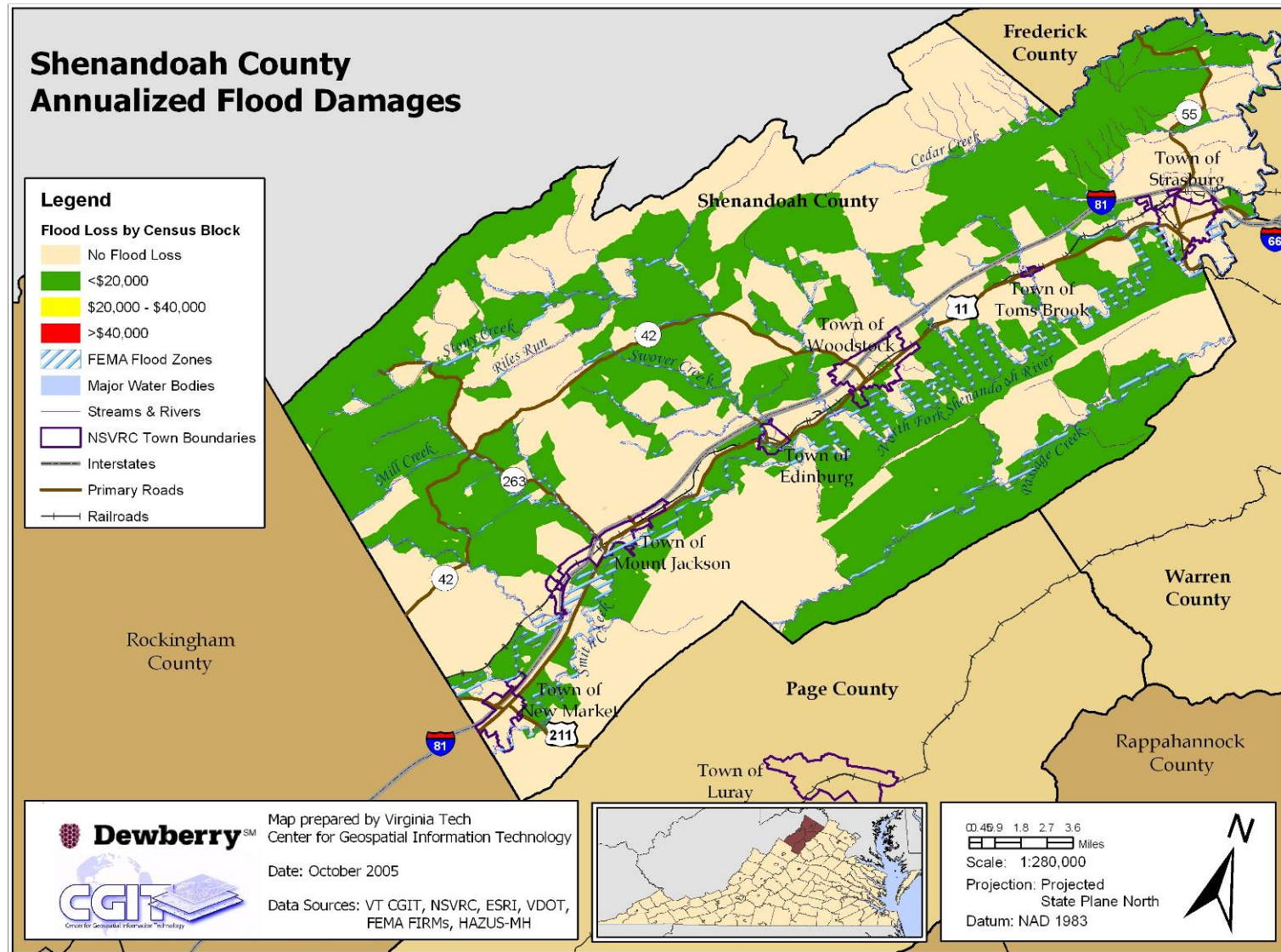
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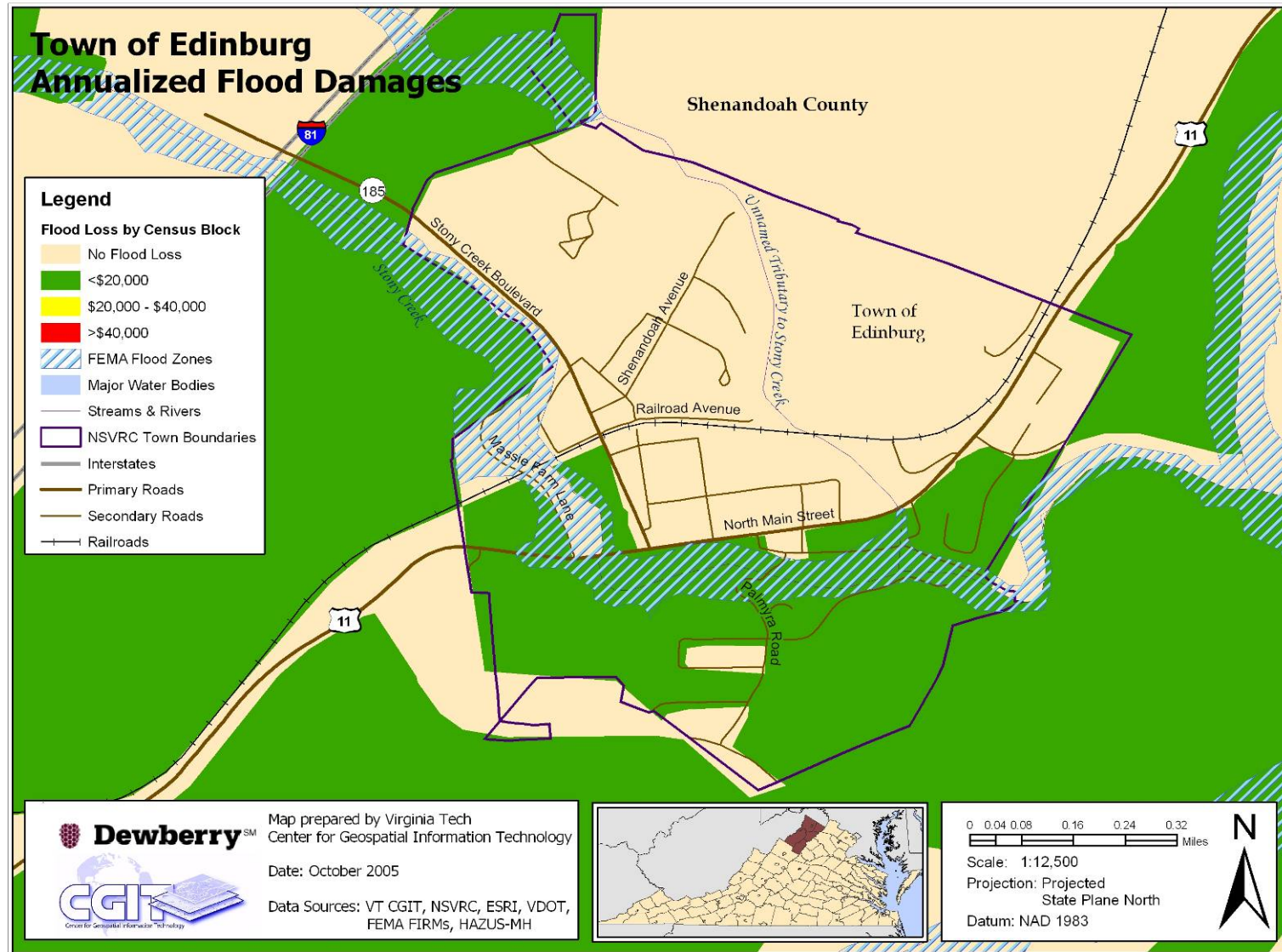
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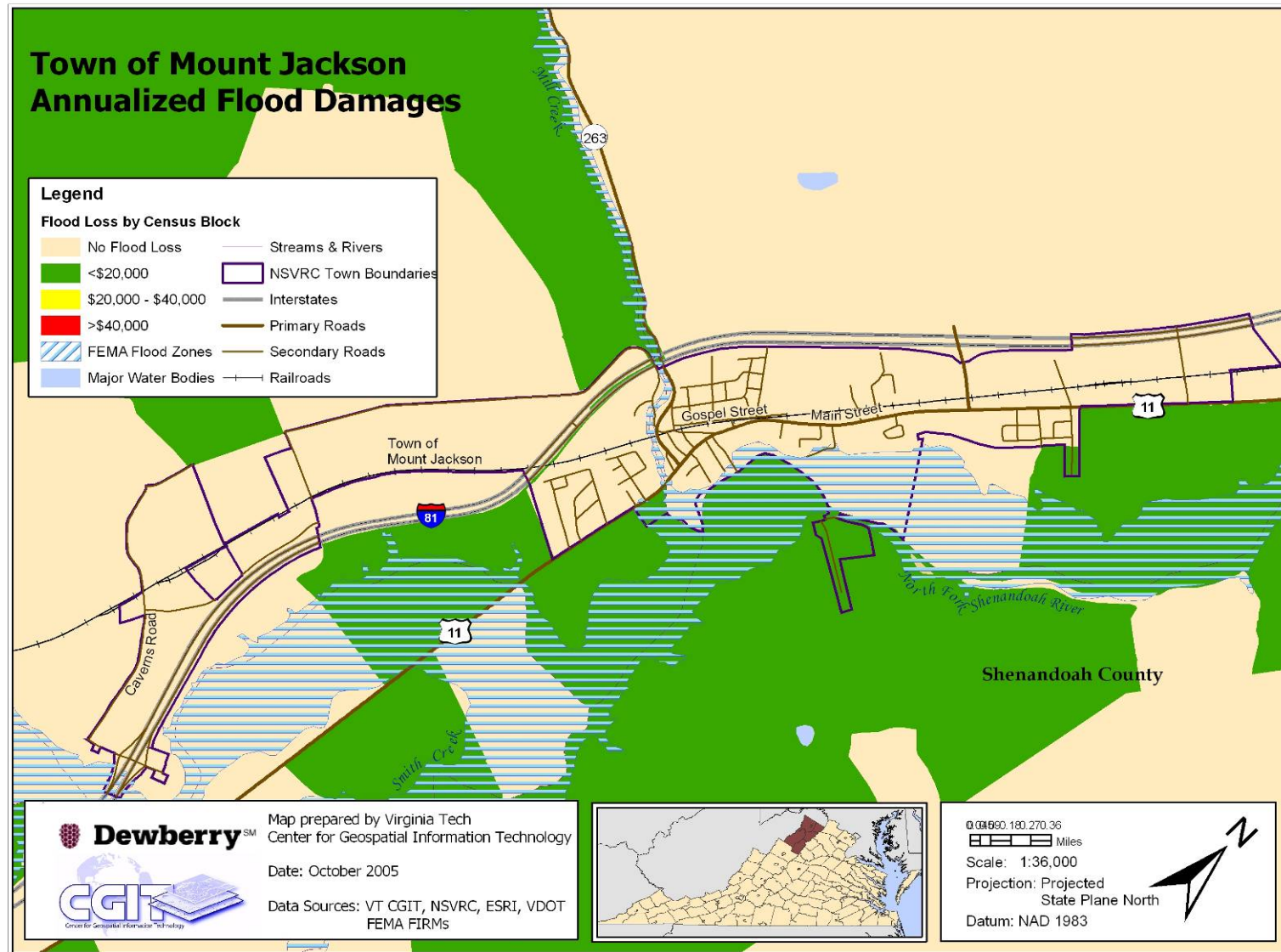
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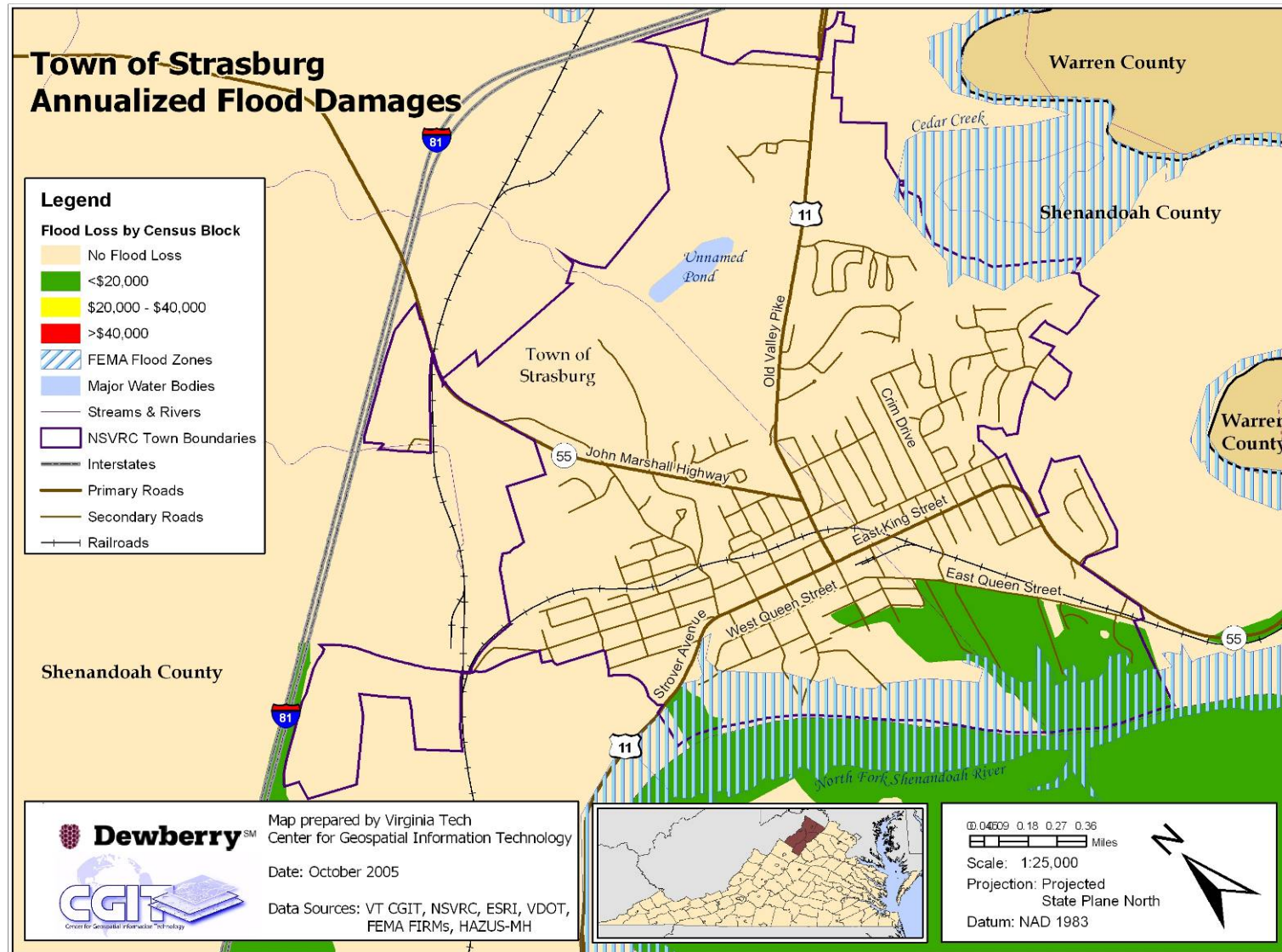
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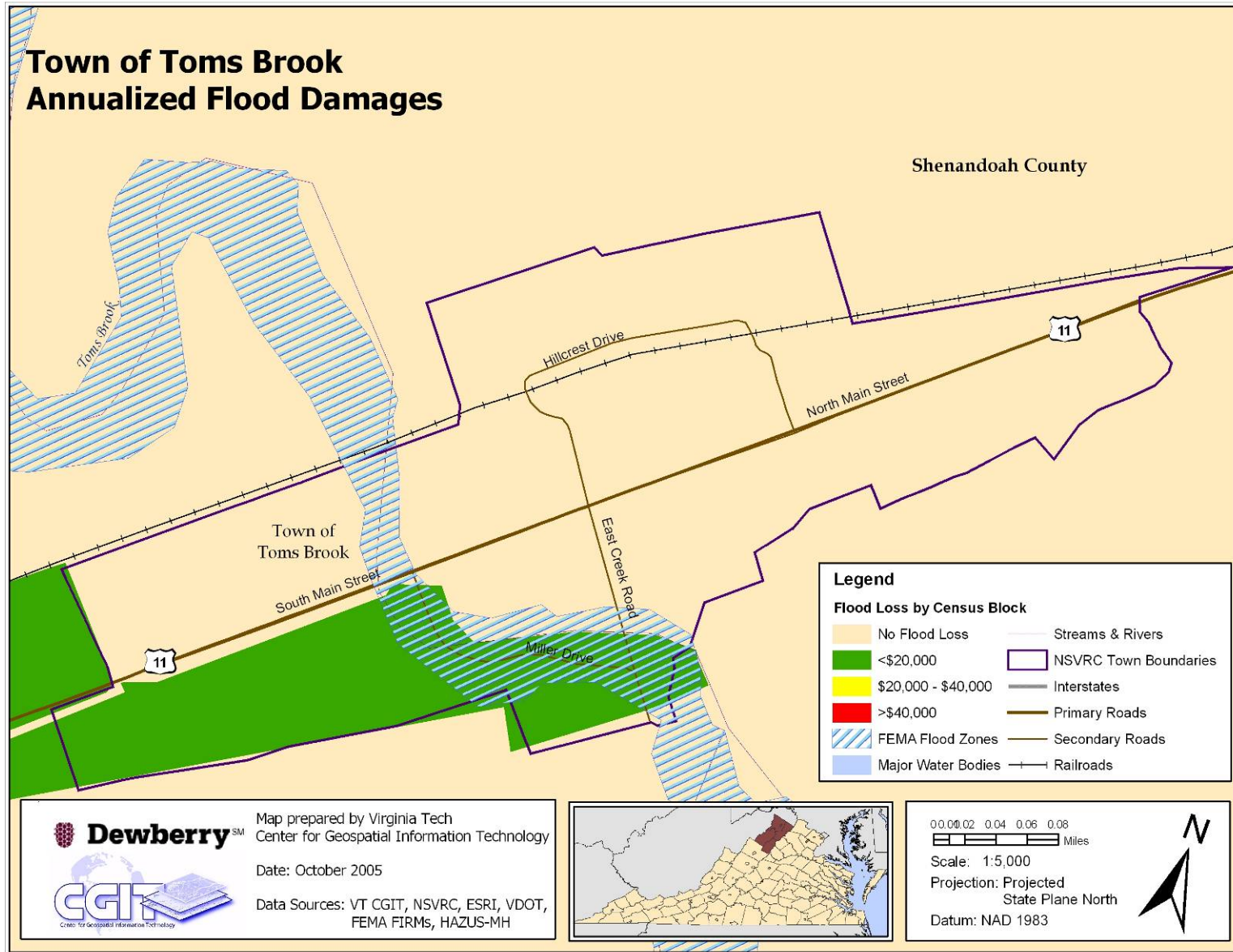
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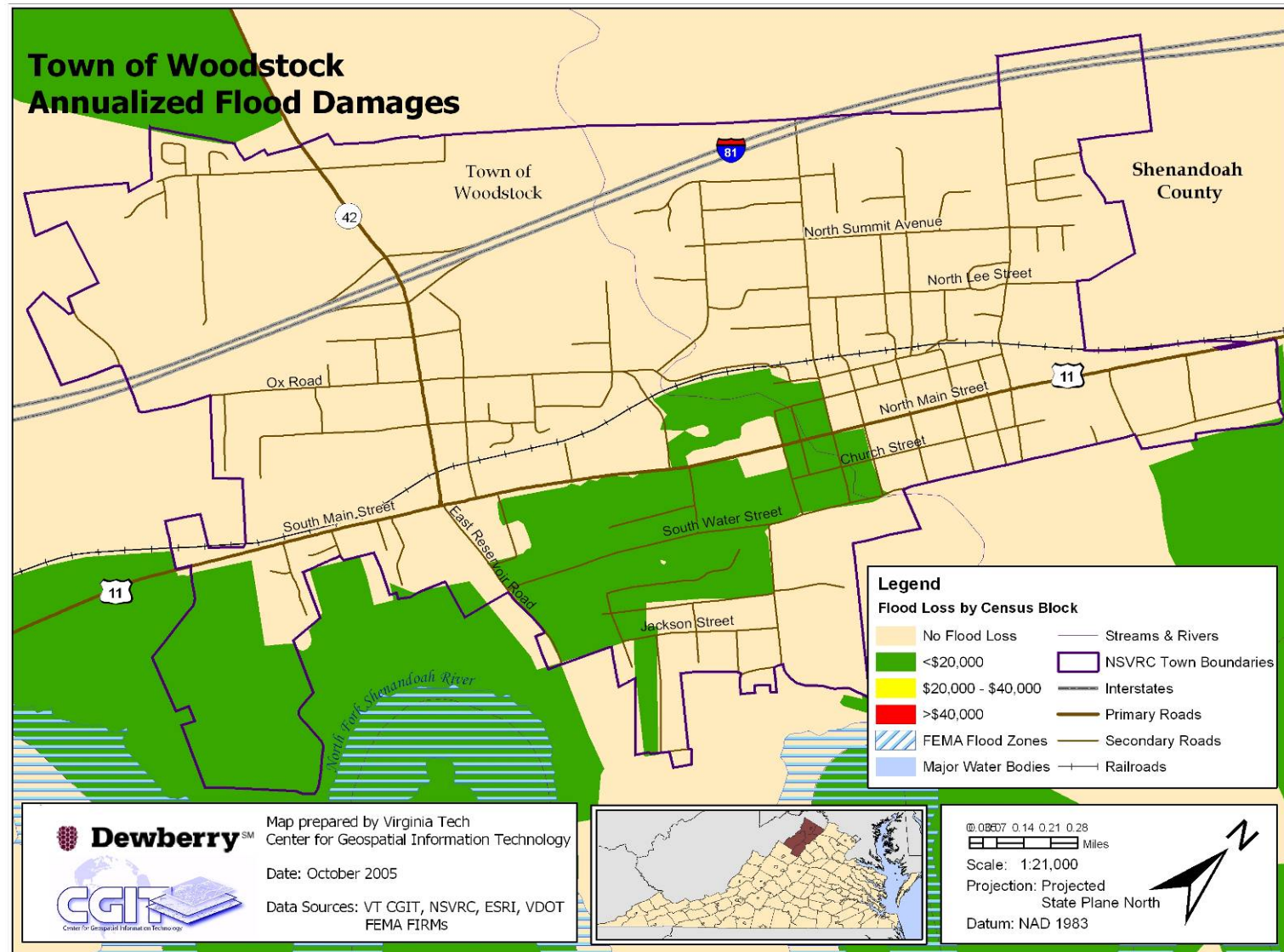
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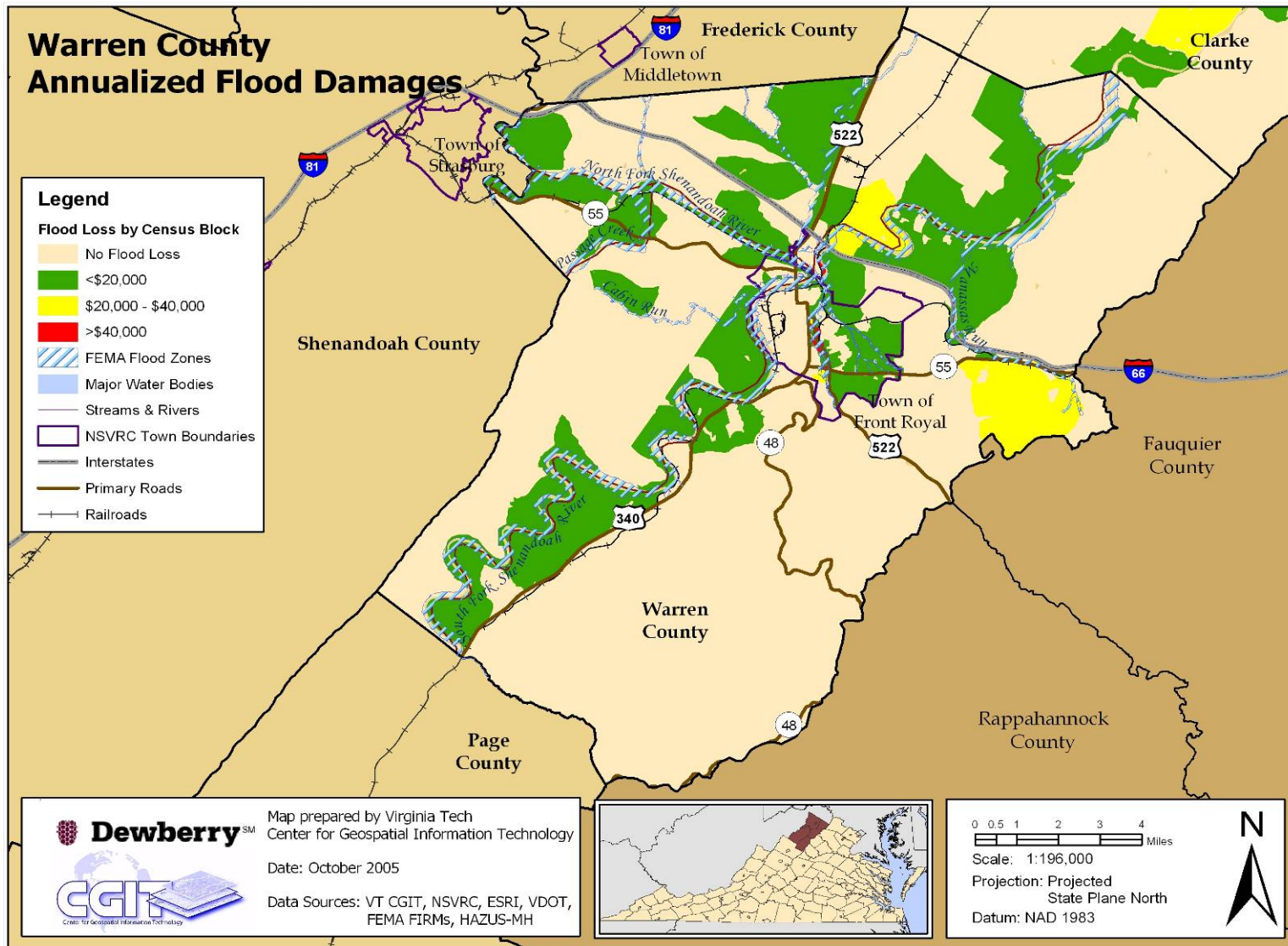
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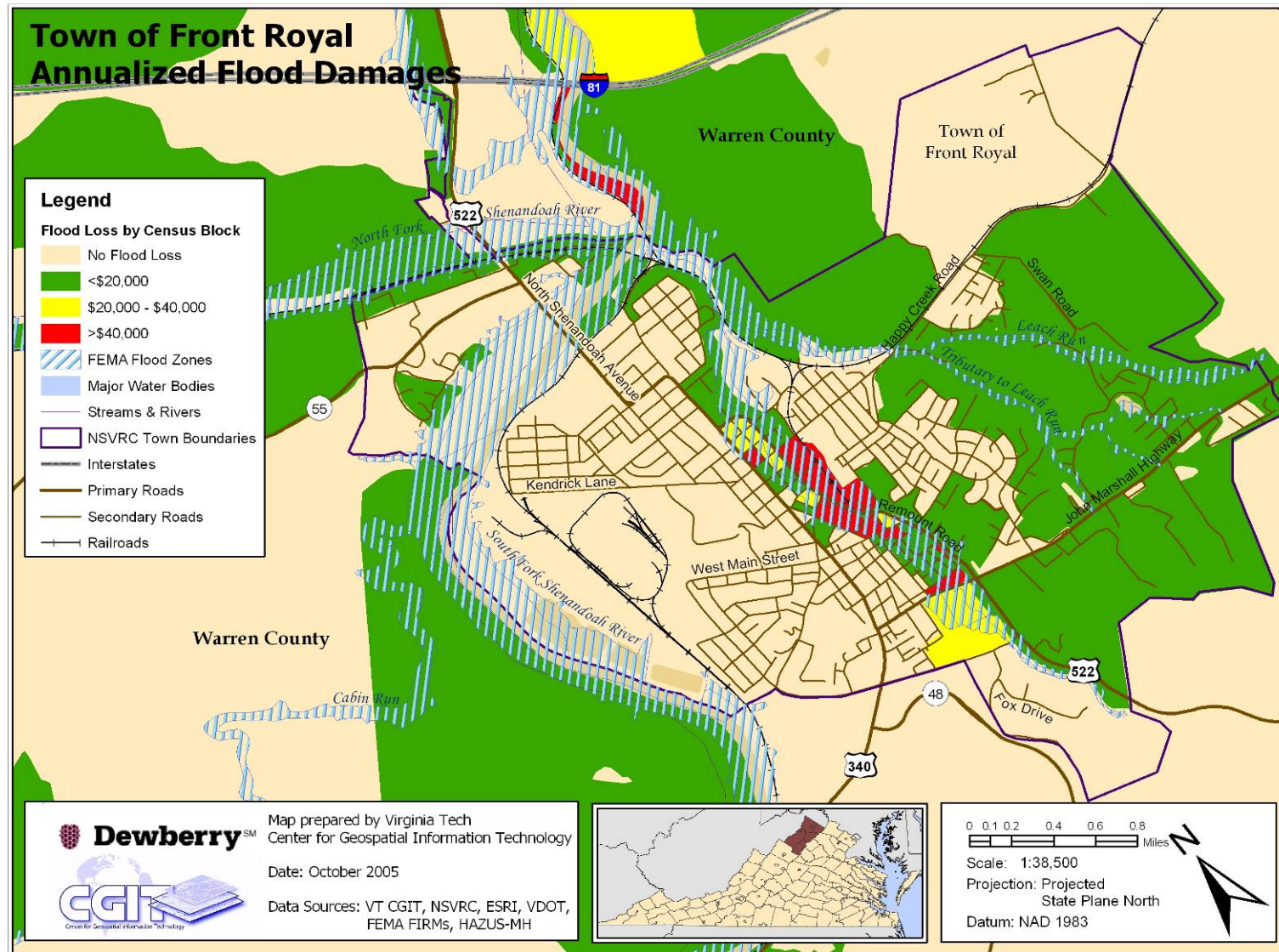
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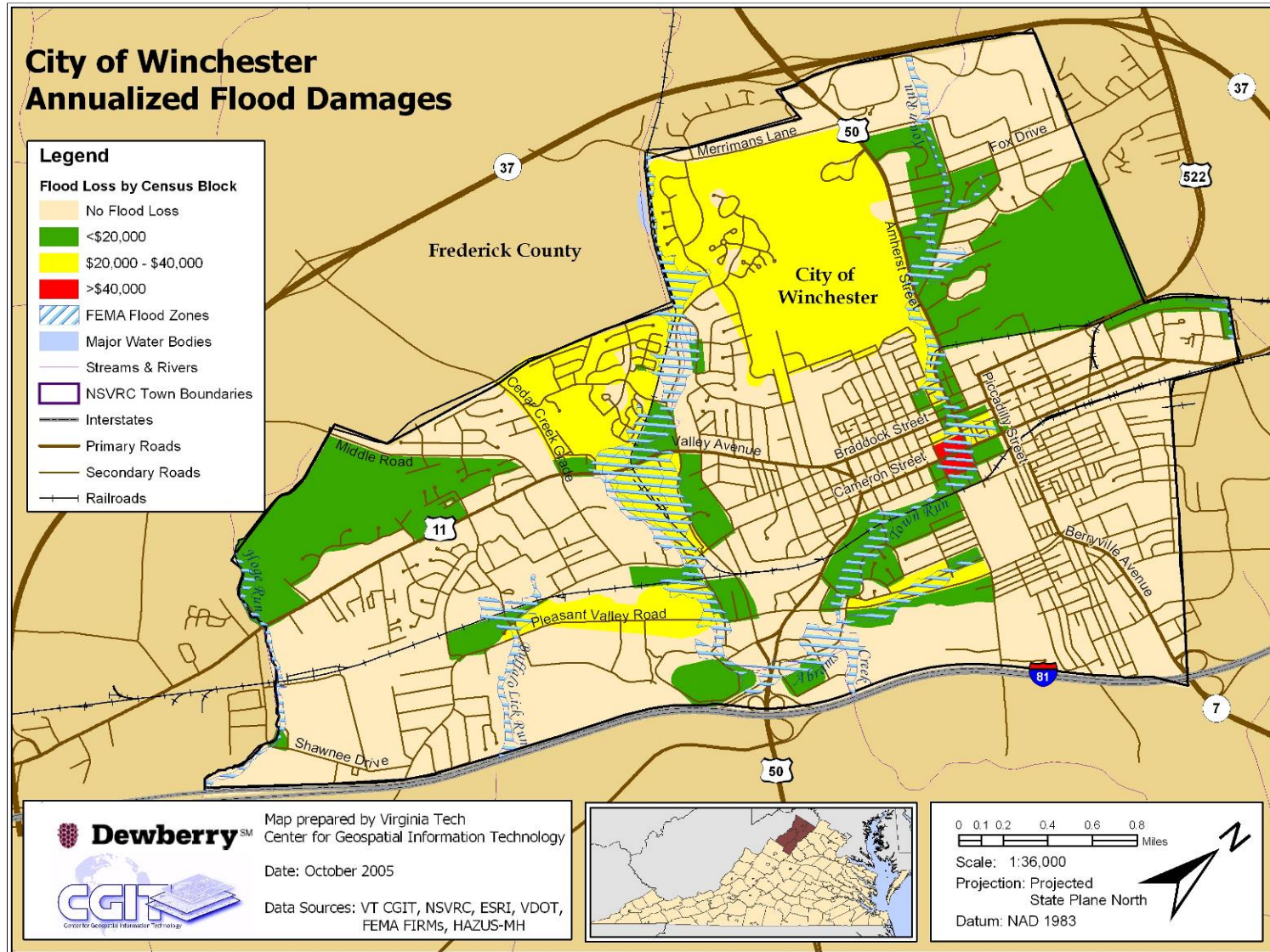
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Appendix E. Repetitive Flood Loss Properties

Table E-1. Northern Shenandoah Repetitive Loss Structures (as of 12/31/2003)

Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
BERRYVILLE, TOWN OF	NO	2-4 FAMILY	A	\$120,900	\$128,591	\$0	2	\$128,591	\$64,296
CLARKE COUNTY	NO	SINGLE FAMILY	C	\$86,400	\$38,573	\$3,939	2	\$42,512	\$21,256
CLARKE COUNTY	YES	SINGLE FAMILY	C	\$199,500	\$109,241	\$49,606	2	\$158,847	\$79,423
CLARKE COUNTY	NO	SINGLE FAMILY	C	\$24,025	\$26,708	\$3,549	2	\$30,258	\$15,129
CLARKE COUNTY	NO	SINGLE FAMILY	C	\$47,640	\$65,798	\$16,500	3	\$82,298	\$27,433
CLARKE COUNTY	YES	SINGLE FAMILY	C	\$63,800	\$18,260	\$93	2	\$18,353	\$9,177
CLARKE COUNTY	YES	SINGLE FAMILY	C	\$46,037	\$6,832	\$6,126	2	\$12,959	\$6,479
CLARKE COUNTY	NO	SINGLE FAMILY	A	\$54,000	\$37,486	\$11,500	2	\$48,986	\$24,493
CLARKE COUNTY	YES	SINGLE FAMILY	A	\$62,974	\$32,180	\$0	2	\$32,180	\$16,090
FREDERICK COUNTY	YES	NON RESIDENT	A	\$119,600	\$25,573	\$58,800	2	\$84,373	\$42,186
FREDERICK COUNTY	NO	NON RESIDENT	EMG	NOT AVAILABLE	\$0	\$4,688	2	\$4,688	\$2,344
FREDERICK COUNTY	NO	NON RESIDENT	A	\$34,000	\$7,724	\$7,737	2	\$15,461	\$7,731
FREDERICK COUNTY	NO	NON RESIDENT	C	\$73,000	\$20,962	\$72,097	4	\$93,059	\$23,265
FRONT ROYAL, TOWN OF	NO	SINGLE FAMILY	EMG	\$25,000	\$21,066	\$5,365	4	\$26,430	\$6,608
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY	AE	\$74,778	\$52,927	\$17,325	2	\$70,252	\$35,126
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY		\$45,660	\$48,949	\$19,639	2	\$68,588	\$34,294
FRONT ROYAL, TOWN OF	YES	ASSUMED CONDO	A	ASSUMED CONDO	\$119,593	\$0	2	\$119,593	\$59,796
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY	A	\$116,000	\$74,612	\$50,000	2	\$124,612	\$62,306
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY	A	\$29,100	\$33,403	\$2,299	2	\$35,702	\$17,851
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY	AE	\$52,500	\$47,831	\$0	2	\$47,831	\$23,915
FRONT ROYAL, TOWN OF	NO	SINGLE FAMILY	AE	\$47,250	\$29,305	\$184	2	\$29,489	\$14,744
FRONT ROYAL, TOWN OF	YES	NON RESIDENT	AE	\$239,000	\$117,571	\$18,300	2	\$135,871	\$67,936
FRONT ROYAL, TOWN OF	NO	SINGLE FAMILY	X	\$97,104	\$62,333	\$29,956	3	\$92,289	\$30,763
FRONT ROYAL, TOWN OF	NO	SINGLE FAMILY	A	\$41,500	\$63,639	\$25,546	3	\$89,185	\$29,728
FRONT ROYAL, TOWN OF	YES	SINGLE FAMILY	A	\$4,500,000	\$40,127	\$16,496	2	\$56,623	\$28,311

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Table E-1. Northern Shenandoah Repetitive Loss Structures (as of 12/31/2003)

Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
FRONT ROYAL, TOWN OF	NO	SINGLE FAMILY	EMG	\$7,000	\$8,273	\$4,300	2	\$12,573	\$6,287
LURAY, TOWN OF	YES	SINGLE FAMILY	A10	\$81,000	\$52,260	\$0	2	\$52,260	\$26,130
LURAY, TOWN OF	NO	SINGLE FAMILY	A10	\$105,840	\$30,674	\$10,007	2	\$40,682	\$20,341
LURAY, TOWN OF	YES	SINGLE FAMILY	AE	\$96,402	\$4,500	\$900	2	\$5,400	\$2,700
LURAY, TOWN OF	YES	SINGLE FAMILY	AE	\$157,323	\$98,817	\$15,000	2	\$113,817	\$56,909
LURAY, TOWN OF	YES	SINGLE FAMILY	A12	\$156,159	\$19,803	\$0	2	\$19,803	\$9,902
LURAY, TOWN OF	NO	SINGLE FAMILY	AE	\$81,000	\$53,938	\$12,400	3	\$66,338	\$22,113
MOUNT JACKSON, TOWN OF	NO	SINGLE FAMILY	A	\$82,000	\$67,474	\$31,250	3	\$98,724	\$32,908
PAGE COUNTY	NO	SINGLE FAMILY	X	\$31,500	\$46,689	\$25,000	2	\$71,689	\$35,845
PAGE COUNTY	YES	SINGLE FAMILY	X	\$101,100	\$33,604	\$14,171	2	\$47,774	\$23,887
PAGE COUNTY	NO	SINGLE FAMILY	X	\$40,000	\$28,857	\$10,106	2	\$38,963	\$19,482
PAGE COUNTY	NO	SINGLE FAMILY	A	\$36,183	\$31,630	\$7,275	2	\$38,905	\$19,452
PAGE COUNTY	NO	SINGLE FAMILY	C	\$52,773	\$23,642	\$8,085	2	\$31,727	\$15,863
PAGE COUNTY	YES	SINGLE FAMILY	X	\$48,400	\$50,613	\$14,704	3	\$65,317	\$21,772
PAGE COUNTY	NO	SINGLE FAMILY	A	\$68,340	\$97,846	\$19,202	2	\$117,048	\$58,524
PAGE COUNTY	YES	SINGLE FAMILY	A	\$83,500	\$16,916	\$0	2	\$16,916	\$8,458
PAGE COUNTY	YES	SINGLE FAMILY	X	\$98,094	\$13,674	\$6,447	2	\$20,121	\$10,060
PAGE COUNTY	NO	SINGLE FAMILY	A	\$77,663	\$113,816	\$41,302	2	\$155,117	\$77,559
PAGE COUNTY	YES	SINGLE FAMILY	AE	\$108,397	\$4,966	\$0	2	\$4,966	\$2,483
PAGE COUNTY	NO	SINGLE FAMILY	A	\$43,200	\$50,779	\$6,360	2	\$57,139	\$28,569
PAGE COUNTY	YES	SINGLE FAMILY	A	\$52,877	\$50,857	\$20,000	2	\$70,857	\$35,428
SHENANDOAH COUNTY	YES	SINGLE FAMILY	X	\$106,920	\$14,639	\$1,641	2	\$16,280	\$8,140
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$66,000	\$19,443	\$3,093	2	\$22,535	\$11,268
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$105,000	\$123,317	\$17,820	2	\$141,137	\$70,568
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$35,100	\$49,139	\$3,258	3	\$52,398	\$17,466
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$48,400	\$34,260	\$5,407	2	\$39,667	\$19,833
SHENANDOAH COUNTY	NO	SINGLE FAMILY	C	\$71,605	\$85,966	\$19,942	2	\$105,908	\$52,954

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Table E-1. Northern Shenandoah Repetitive Loss Structures (as of 12/31/2003)

Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$41,960	\$45,969	\$0	2	\$45,969	\$22,984
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$64,400	\$53,313	\$9,460	2	\$62,773	\$31,386
SHENANDOAH COUNTY	NO	SINGLE FAMILY	AE	\$103,681	\$98,683	\$2,058	2	\$100,741	\$50,370
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$12,800	\$30,107	\$3,400	3	\$33,507	\$11,169
SHENANDOAH COUNTY*	NO	SINGLE FAMILY	C	\$106,163	\$139,212	\$31,209	3	\$170,421	\$56,807
SHENANDOAH COUNTY*	YES	SINGLE FAMILY	A	\$126,000	\$97,877	\$0	2	\$97,877	\$48,939
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$41,600	\$44,549	\$1,063	3	\$45,612	\$15,204
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$53,808	\$52,079	\$14,652	2	\$66,731	\$33,365
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$51,580	\$55,187	\$43,734	2	\$98,921	\$49,461
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$55,700	\$20,193	\$3,985	2	\$24,179	\$12,089
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$45,760	\$29,372	\$9,391	2	\$38,763	\$19,381
SHENANDOAH COUNTY*	YES	SINGLE FAMILY	X	\$87,120	\$55,764	\$7,551	2	\$63,314	\$31,657
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$44,640	\$44,344	\$0	2	\$44,344	\$22,172
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$23,000	\$29,836	\$6,058	2	\$35,894	\$17,947
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$80,000	\$25,907	\$9,023	2	\$34,930	\$17,465
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$36,000	\$25,267	\$0	2	\$25,267	\$12,634
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$36,225	\$39,454	\$12,843	2	\$52,297	\$26,149
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$63,000	\$41,589	\$0	2	\$41,589	\$20,795
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$41,956	\$24,068	\$7,161	2	\$31,229	\$15,614
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$124,200	\$53,450	\$0	3	\$53,450	\$17,817
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$154,055	\$32,086	\$0	3	\$32,086	\$10,695
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$91,800	\$39,133	\$0	3	\$39,133	\$13,044
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$99,068	\$52,118	\$7,500	2	\$59,618	\$29,809
SHENANDOAH COUNTY	NO	SINGLE FAMILY	C	\$63,006	\$54,652	\$30,267	2	\$84,919	\$42,460
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$55,990	\$56,800	\$10,000	2	\$66,800	\$33,400
SHENANDOAH COUNTY	YES	SINGLE FAMILY	A	\$140,968	\$101,612	\$7,296	2	\$108,908	\$54,454
SHENANDOAH COUNTY	NO	SINGLE FAMILY	C	\$111,384	\$85,222	\$28,361	2	\$113,583	\$56,792

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Table E-1. Northern Shenandoah Repetitive Loss Structures (as of 12/31/2003)

Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
SHENANDOAH COUNTY	YES	NON RESIDENT	A	\$84,376	\$13,002	\$322,900	2	\$335,902	\$167,951
SHENANDOAH COUNTY**	YES	SINGLE FAMILY	X	\$68,900	\$18,072	\$6,800	2	\$24,872	\$12,436
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$104,500	\$67,174	\$14,308	2	\$81,482	\$40,741
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$40,000	\$78,299	\$3,200	3	\$81,499	\$27,166
SHENANDOAH COUNTY*	YES	SINGLE FAMILY	A	\$158,400	\$163,338	\$23,584	2	\$186,922	\$93,461
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$76,800	\$77,315	\$12,389	2	\$89,703	\$44,852
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A04	\$46,500	\$27,772	\$20,400	3	\$48,172	\$16,057
SHENANDOAH COUNTY*	YES	SINGLE FAMILY	A	\$46,080	\$32,716	\$15,386	2	\$48,102	\$24,051
SHENANDOAH COUNTY	NO	SINGLE FAMILY	A	\$50,820	\$47,894	\$25,605	2	\$73,499	\$36,749
SHENANDOAH COUNTY	YES	SINGLE FAMILY	C	\$110,000	\$162,831	\$108,198	2	\$271,028	\$135,514
SHENANDOAH COUNTY*	NO	SINGLE FAMILY	A	\$68,300	\$85,527	\$27,476	2	\$113,003	\$56,502
SHENANDOAH COUNTY*	NO	SINGLE FAMILY	C	\$97,600	\$75,035	\$51,971	2	\$127,006	\$63,503
STANLEY, TOWN OF	YES	SINGLE FAMILY	X	\$62,400	\$42,447	\$6,200	2	\$48,647	\$24,323

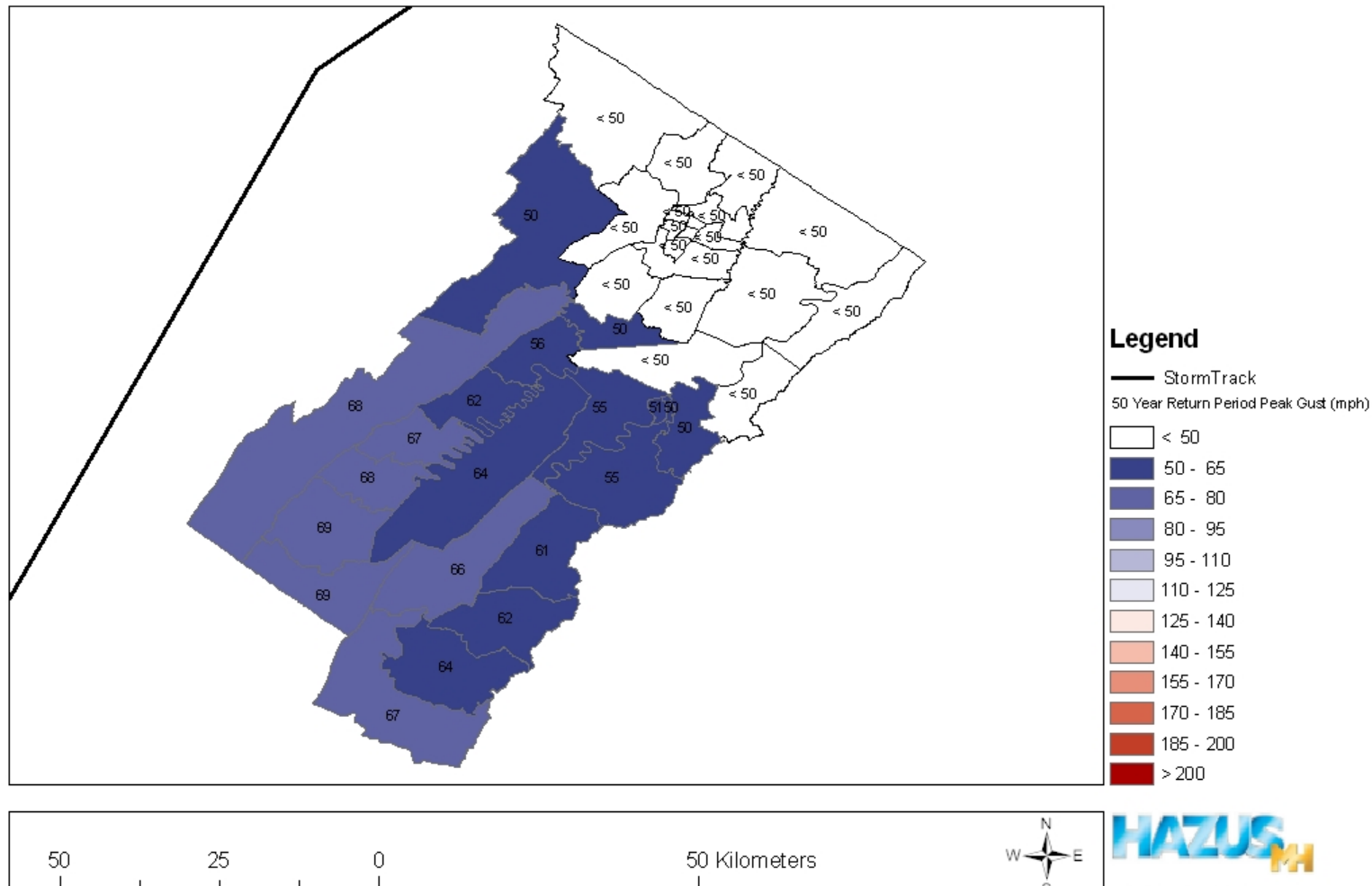
* Denotes properties that have since been acquired by the county.

** Denotes properties that have since been elevated by the county.

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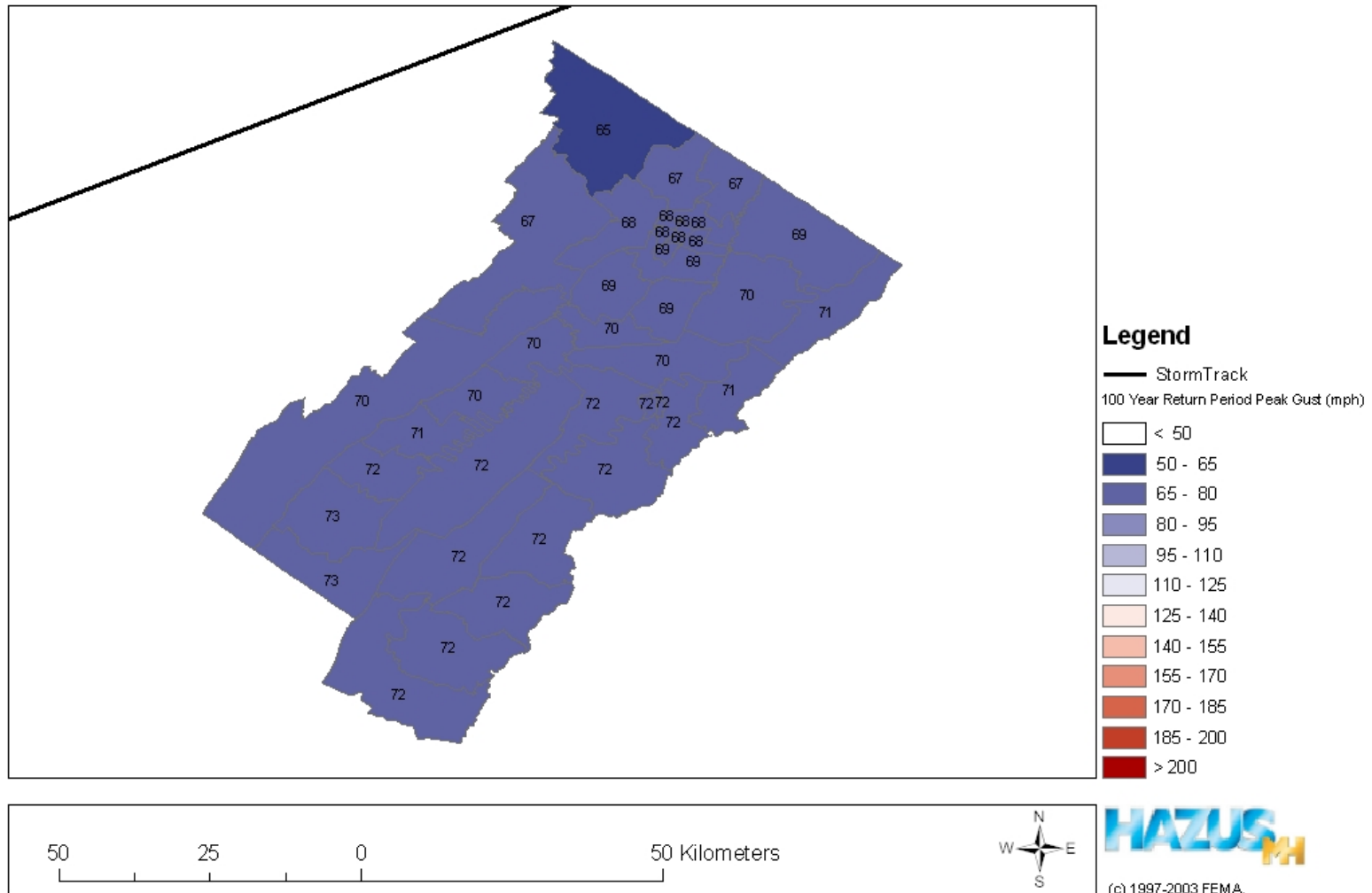
Appendix F. Wind Hazard Maps

Study Region: Northern Shenandoah Valley RC
Current Scenario: Probabilistic 50-Year Wind Event



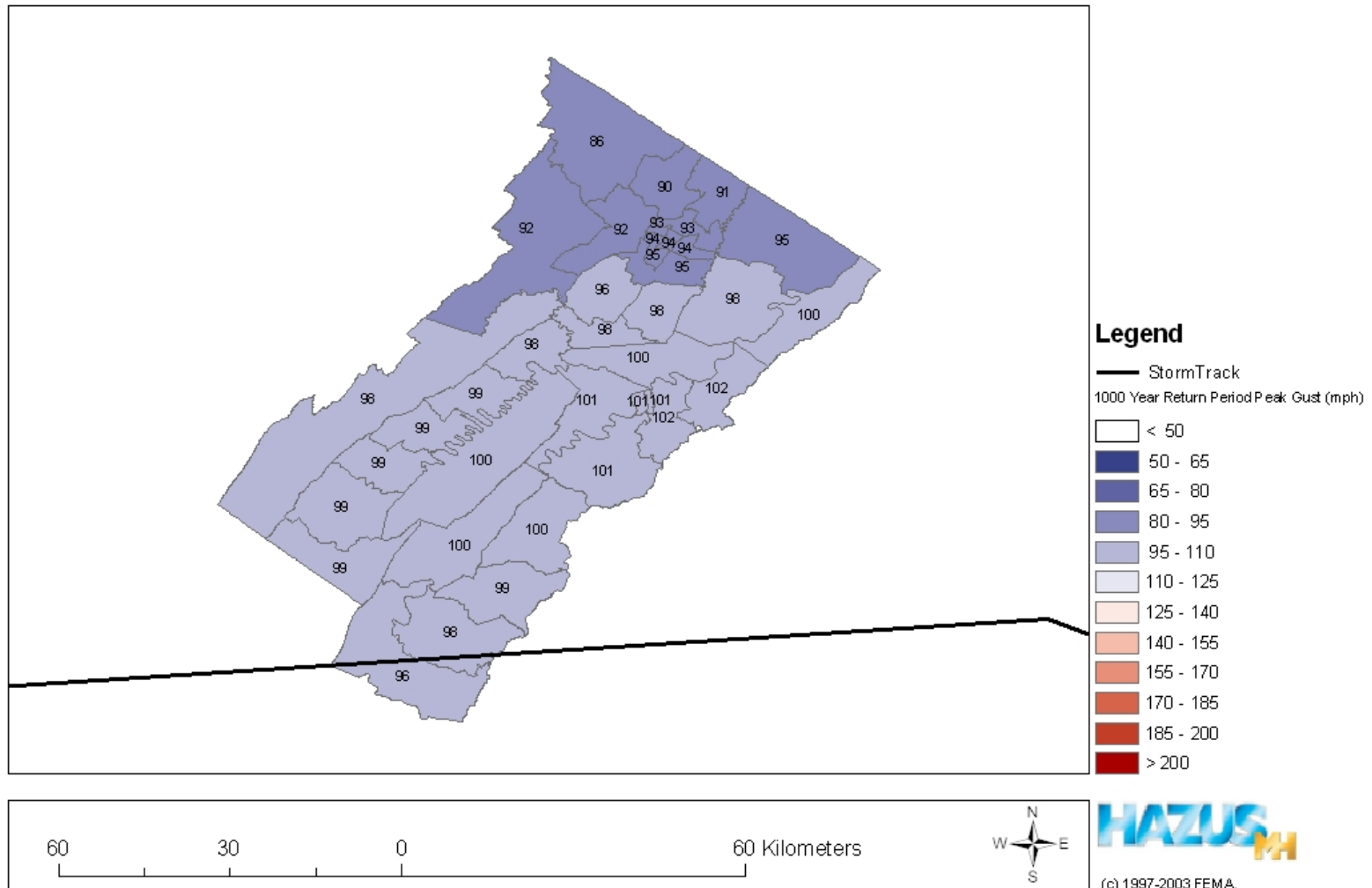
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Study Region: Northern Shenandoah Valley RC
Current Scenario: Probabilistic 100-Year Wind Event



Northern Shenandoah Valley Multi-Jurisdictional Hazard Mitigation Plan

Study Region: Northern Shenandoah Valley RC
Current Scenario: Probabilistic 1000-Year Wind Event



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Appendix G. Guide to Mitigation Strategies¹

Mitigation strategies or activities fall into six general categories. These categories are explained in the next section. The second and third sections provide more detail on common mitigation activities.

I. General Categories

Prevention

Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or where capital improvements have not been substantial. Examples of preventative activities include:

- Open space preservation
- Storm water management
- Drainage system maintenance
- Shoreline/riverine setbacks
- Capital Improvement Plans/critical facility placement
- Special assessment districts

Local land use plans and ordinances can be used to limit development in hazard-prone areas or to prevent areas from becoming worse. Examples of local enforcement tools that can be used include:

- Planning and zoning
- Floodplain regulations

Property Protection

Property protection measures protect new or existing structures by modifying buildings to withstand hazardous events, or removing structures from hazardous locations. Examples include:

¹ This document is based, in part, on the City of Chesapeake (VA) Hazard Mitigation Plan. Portions of this document also were drawn from the *Tools and Techniques: An Encyclopedia of Strategies to Mitigate the Impact of Natural Hazards* developed by the State of North Carolina in 2002, and the *Planning for Natural Hazards: Oregon Technical Resource Guide* developed by the Oregon Natural Hazards Workgroup, Community Service Center at the University of Oregon.

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- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Building codes (enforcement)
- Safe rooms
- Basement backflow prevention
- Retrofitting (i.e., windproofing, floodproofing, seismic design standards, etc.)
- Wind shutters

Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their mitigation functions. Such areas include floodplains, wetlands, and dunes. Parks, recreation, or conservation agencies and organizations often implement these measures. Examples include:

- Floodplain protection
- Riparian buffers
- Vegetative planting and treatment / slope stabilization / fire-resistant landscaping
- Fuel breaks
- Wetland preservation and restoration

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the natural environmental progression of the hazard event. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Channel modification
- Levees / dikes / floodwalls
- Diversions / detention / retention
- Reservoirs
- Utility protection / upgrades
- Wind retrofitting / windproofing

Emergency Services

Although not typically considered a “mitigation technique,” emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

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- Warning systems
- Evacuation planning and management
- Sandbagging for flood protection

Public Information and Awareness

Public information and awareness activities are used to advise residents, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Speaker series/demonstration events
- School children education
- Hazard map information
- Hazard expositions
- Real estate disclosure
- Websites
- Library materials

II. General Multi-Hazard Mitigation Activities

The following potential mitigation activities can be used to address one or more hazards. These activities also can benefit a community's overall hazard reduction efforts. Activities that are specific to a particular hazard are explained in the third section.

The mitigation activities selected should be linked to the Planning District's goals and objectives, and must address each jurisdiction's hazard risks and vulnerability outlined in the plan's Hazard Identification and Risk Assessment.

Building Codes

Building codes regulate the design, construction, and maintenance of construction within most communities. These regulations prescribe standards and requirements for occupancy, maintenance, operation, construction, use, and appearance of buildings. Building codes are an effective way to ensure that new and extensive re-development projects are built to resist natural hazards. In Virginia, communities are required by law to adopt and enforce the Uniform Statewide Building Code, which has provisions for wind, water, and seismicity. Changes to the code are made by petitioning the International Code Council.

The USBC provides optional enforcement regulations to protect occupants of existing buildings and structures from health and safety hazards arising from the improper maintenance and use of those buildings and structures. Enforcement of the building code for new and existing structures is key to realizing the full health and safety benefits of the code.

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Capital Improvement Plans/Critical Facility Placement

Capital improvement plans typically provide for the future and ongoing provision of public facilities and infrastructure. These plans can be vital tools in keeping new development out of high-hazard areas by limiting the availability of public infrastructure. Public facilities can often be relocated to less hazardous areas in the aftermath of a disaster. Public utilities also can be relocated, or they can be upgraded or floodproofed. Power and telephone lines can be buried underground.

In order to maximize the gravity flow area of wastewater treatment plants, the facilities are often located at the lowest elevation in the community. If this point lies within a floodplain for example, consideration may be given to relocating or floodproofing such facilities. New locations for critical facilities should not be in hazard-prone areas, or in areas where their function may be impaired by a given hazard event (i.e., where water can flood the access roads). Critical facilities should be designed and/or retrofitted in order to remain functional and safe before, during, and after a hazard event.

Comprehensive Plans

Comprehensive plans address how and where a community should grow by guiding the rate, intensity, form, and quality of physical development. These plans address land use, economic development, transportation, recreation, environmental protection, the provision of infrastructure, and other municipal functions. Comprehensive plans help to guide other local measures such as capital improvement programs, zoning ordinances, subdivision ordinances and other community policies and programs. By including natural hazard considerations into the plan, mitigation becomes integrated with community functions and could therefore be an institutionalized part of a jurisdiction's planning efforts.

Density and development patterns should reflect the Planning District communities' ability to protect their jurisdictions, the environment, and the ability to evacuate the area. Development management tools should be incorporated into the local policies that address the location, density, and use of land, with a particular emphasis on development within high-risk areas. Efforts should be made to keep people and property out of high-hazard areas whenever possible. Particularly hazardous areas could be used for recreational uses, open space, or wildlife refuges.

Critical Facilities Protection

Critical facilities, such as hospitals, fire and police stations, and sewage treatment plants are crucial for day-to-day survival of a community. Ensuring that these facilities have been built to withstand the impacts of natural disasters is crucial. This includes placement of the

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buildings in areas that are not hazard-prone and incorporating mitigation measures such as floodproofing, wind shutters, and hurricane straps into the construction of the building.

Evacuation Planning and Management

An orderly and safe evacuation requires planning and a pre-determined management strategy. This includes pre-identifying emergency evacuation routes and communicating that information to the public. In addition, people needing assistance, such as the elderly or those with special needs, should be identified and plans made to assist them if an evacuation were to occur.

Another component of evacuation planning is ensuring that shelter facilities will be available. Potential shelter locations must be identified and publicized and efforts must be made to ensure that the proper supplies and staff are available if the shelter is activated.

Neighborhood Access

Provide additional means of access into single-entry neighborhoods, in order to prevent residents from becoming trapped in a hazardous area during a wildfire or flood.

Public Outreach and Education Programs

Educating the public about what actions they can take to protect themselves and their property from the effects of natural hazards can be an effective means for reducing losses. These types of programs could target public officials, citizens, businesses, or the local construction trade. The program could cover preparedness, recovery, mitigation, and general hazard awareness information. Potential outreach and education topics include:

- Flood insurance
- Hazard mitigation for homeowners (including manufactured homes and trailers), renters, and businesses
- Emergency preparedness for families, businesses, and special needs populations
- Driver safety in disasters
- Sheltering and evacuation

Ways of delivering this information include:

- Speaker series / demonstration events
- Hazard expositions
- Hazard curriculums for schools
- Hazard map dissemination
- Real estate disclosure
- Library materials
- Websites

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Special Assessment Districts

Special assessment districts apply to property owners who directly benefit from a specific public improvement. These owners of both new and existing development in the district are charged a fee that is proportional to the benefits received from the improvement. There are a number of ways to apply this technique, from temporary assessments that raise revenue for a specific improvement to indefinite assessments that fund independent, special purpose governmental entities. The former could be used to fund structural projects, such as a floodwall, while the latter could be used to establish a regional floodplain management organization.

Another example might be the creation of a “special storm services” district, where funds would go toward mitigation, recovery and response activities. In other cases, the fee could be used to pay for the upkeep of stormwater management system or as a way of providing for the future replacement of roads and utilities at the public expense. These charges may or may not have the effect of discouraging development in the assessment district. However, they do transfer some of the cost of living or doing business in a hazard-prone area to those who choose to do so.

Utility Protection/Upgrading

Buried power lines can offer uninterrupted power during and after severe storms (both wind and winter storms). Burying power lines can significantly enhance a community’s ability to recover in the aftermath of a disaster. Buried power lines are typically more expensive to maintain and are more vulnerable to flooding. Encouraging back-up power resources in areas where burial is not feasible will enable the continuity of basic operations (e.g., security, refrigeration, and heat) for businesses and facilities when there is a loss of power.

Vegetative Maintenance

Vegetative maintenance is the pruning and maintenance of trees, bushes, and other vegetation that could increase threats to power lines during storms, or could act as fuels during wildfires. This could be applied in limited areas that have a significant vulnerability to these hazards, such as within utility easements or along the urban-wildland interface.

Vegetative Planting and Treatment/ Fire-resistant landscaping

Vegetative planting and treatments can help to capture and filter runoff or reduce wildfire risk depending on the types of plants used. Perennial vegetation includes grass, trees, and shrubs that cover the soil, reduce water pollution, slow the rate of runoff, increase filtration, and prevent erosion. This type of land treatment includes maintaining trees, shrubberies, and the vegetative cover; terracing (i.e., a raised bank of earth with vertical sloping sides and a flat top to reduce surface runoff); stabilizing slopes; grass filter strips; contour plowing; and

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strip farming (i.e., the growing of crops in rows along a contour). Other potential options include vegetated swales, infiltration ditches, and permeable paving blocks.

Landscaping also makes a difference in the vulnerability of a property to wildfire.

Warning Systems

Warning systems are comprised of two components: monitoring of local conditions and the broadcasting of alerts. An example of monitoring is a system of stream gauges that provide real-time data.

The National Weather Service uses broadcasts via NOAA Weather Radio to alert communities of meteorological events such as floods and tornadoes. Reverse 911 systems and the media (e.g., television, radio) also can be used to alert residents to hazardous situations.

Zoning

Zoning is by far the most common land use control technique used by local governments. While a useful tool for regulating and restricting undesirable land uses, zoning has a somewhat more limited benefit when it comes to mitigation. Zoning is most effective on new development rather than existing development, which does little to address the pre-existing development in hazardous areas. Communities with a large amount of undeveloped land will benefit much more than older, more established communities.

A community might create an overlay zone for high-hazard districts that establishes mitigation requirements for development in those districts. Overlays are also useful for periods of reconstruction. A recovery overlay zone would include temporary planning regulations that might strictly limit reconstruction in the hazard area or could require any new development to include hazard mitigation techniques. The overlay zone would remain transparent until it was triggered by a disaster event.

Even for new development, the issuance of variances, special use permits, rezoning, and the failure to enforce existing codes, however, will weaken zoning's ability to prevent certain types of building practices.

III. Hazard-Specific Activities

The following is a list of potential mitigation activities that are hazard-specific.

Flood

Flood mitigation measures can be classified as structural or non-structural. In simple terms, structural mitigation attempts to eliminate the possibility of flooding at a particular location. Non-structural mitigation removes the potentially affected people or property from the

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potentially flooded area. The following is a description of potential flood mitigation measures.

Floodplain Management Ordinances

Floodplain management addresses the hazard risk of communities partially or entirely located in a floodplain. Floodplain management ordinances should restrict development that would increase flood heights and ensure that construction materials and methods used will minimize future flood damage.

Floodplain management ordinances are weakened by development pressures, a lack of suitable sites outside of the floodplain, community desires to be near the water, inability to effectively monitor floodplain management activities, or by land use planning policies that are encouraging development into floodplain areas.

Acquisition

Acquisition involves the purchasing of property in a hazardous area, which is subsequently cleared and permanently held as open space. Acquisition permanently moves people and property out of harm's way, increases floodplain capacities, recreation areas and open space, and can help to preserve wetlands, forests, estuaries and other natural habitats. Participation in federally-funded grant programs requires voluntary participation by the owner.

Acquisition programs can be expensive to undertake, and the property will no longer accrue taxes for the community and must be maintained, but it is by far the most effective and permanent mitigation technique. Acquisition is most effective when targeting repetitive loss structures, extremely vulnerable structures, or other high-hazard areas.

Basement Backflow Prevention

Check valves, sump pumps, and backflow prevention devices in homes and buildings can be used to prevent flooding in basements from sewer backflows. This option can be done only if the infrastructure allows it.

Channel Modification

Changes to the stream bed, such as dredging or lining the channel, can improve the flow and capacity of the stream. By improving the ability of the stream to move surplus water, the flood risk can be reduced. Channelization projects are designed to move water quickly away from developed areas.

Dry Floodproofing

Dry floodproofing involves making all areas below the flood protection level watertight by strengthening walls, sealing openings, using waterproof compounds, or applying plastic

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sheeting on the walls. This method is not recommended for residential structures, but may work well for new construction, retrofitting, or repairing a non-residential structure. Due to pressure exerted on walls and floors by floodwater, dry floodproofing is effective on depths less than 2 to 3 feet. Floodproofing of basements is not recommended.

Elevation

Elevation is the raising of a structure above the Base Flood Elevation. Elevation is often the best alternative for structures that must be built or remain in flood-prone areas, and is less costly than acquisition or relocation. However, elevating a structure can increase its vulnerability to high winds and earthquakes. Some building types are either unsuitable or cost-prohibitive to elevate.

Open Space Preservation

Local government can purchase land to prevent development from occurring in hazard-prone areas. Land can be bought through fee simple purchase or conservation easements could be sought. The land can be used as community open space or for recreational purposes, potentially meeting other community goals.

Relocation

Relocation involves the moving of a building or facility to a less hazardous area, on either the same parcel or another parcel. This measure also moves people and property out of harm's way, and is a very effective measure overall. Some building types are either unsuitable or cost-prohibitive to relocate.

Reservoirs

Reservoirs can be used to store water for various purposes including municipal water sources, recreational uses, and flood control. Water can be stored and released at a controlled rate so as not to overwhelm the downstream channel.

Riparian Buffers

Riparian buffers prevent development within a certain distance from a stream or river. The buffer typically retains its natural vegetation that often can retain greater amounts of water than bare soil and thus help to mitigate flood level. The plant roots hold soil in place and slow movement of floodwaters, lessening erosion and sedimentation, while increasing groundwater infiltration. This increased groundwater infiltration may also improve water quality by reducing the amount of sediment and pollutants flowing into the stream.

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Sandbagging

“Sandbags can be used to fill gaps in a permanent protection system, to raise an existing levee or to build a complete emergency levee. Sandbags alone, when filled and stacked properly, can hold back flood water, but they are most effective when used with polyethylene (plastic) sheeting.”²

Shoreline / Riverine Setbacks

Setbacks establish a minimum distance between an existing shoreline or stream/river and the buildable portion of a lot. By moving the building away from a potential hazard, the risk to the building is reduced. Setbacks also may be used to move development away from steep slopes that are at risk for failure (e.g., landslide).

Stormwater Management / Storm Drainage Systems / Retention and Detention Facilities

New development that increases the amount of impervious surfaces affects the land's ability to absorb the water and can intensify the volume of peak flow runoff. Without efficient stormwater management, runoff could cause flooding, erosion, and water quality problems. Stormwater management plans should incorporate both structural and nonstructural measures in order to be most effective.

Mitigation efforts include the installation, re-routing, or increasing the capacity of storm drainage systems. Examples include the separation of storm and sanitary sewers or drainage easements. Other structural measures include retention and detention facilities that minimize the increase of runoff due to impervious surfaces and new development. Retention facilities allow stormwater to seep into the groundwater. Detention systems accumulate water during peak runoff periods that will be released at off-peak times. Nonstructural measures include establishing impervious surface limit policies and maintenance programs for existing drainage systems.

Stream/Channel Maintenance

Waterways should be cleared of debris to allow for the free flow of water during a flood event. If streams or rivers are clogged with debris, damming could occur. As a result, areas upstream and adjacent to the unintended dam can receive unanticipated higher flood levels. In addition, downstream areas may be vulnerable to higher flooding if and when the dam breaks.

² *Using Sandbags for Flood Protection*. Retrieved from <http://www.louisianafloods.org/Mitigation/sandbagsmain3.html> on December 20, 2004.

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Structural Flood Control Measures

Water can be channeled away from people and property with structural control measures such as levees, dams, or floodwalls. These measures also may increase drainage and absorption capacities. These structural control measures also may increase Base Flood Elevations and therefore could create a false sense of security.

Wet Floodproofing

The opposite of dry floodproofing, wet floodproofing lets the floodwater actually enter a structure. This technique is effective on deeper flood depths, as it does not have the same potential to build up exterior pressure. Again, this method is not recommended for residential structures and may not be used for basements under new construction, substantial improvements, or substantially damaged structures.

Wetland Preservation and Restoration

Wetlands can store floodwaters and decrease overall flow downstream, thereby reducing the flood risk. Wetlands also act as filters for pollutants, therefore, increasing water quality. Its usefulness as a mitigation technique may decrease with the size of the flood.

Wind

Proper engineering and design of a structure can increase a structure's ability to withstand the lateral and uplift forces of wind. Building techniques that provide a continuous load path from the roof of the structure to the foundation are generally recommended.

Community Shelters/Safe Rooms

Community shelters and concrete safe rooms can offer protection and reduce the risk to life. Locations for these shelters or safe rooms are usually in concrete buildings such as shopping malls or schools. Communities lacking basements and other protection nearby should consider developing tornado shelters.

Windproofing

Windproofing is the modification of the design and construction of a building to resist damages from wind events, and can help to protect the building's occupants from broken glass and debris. Windproofing involves the consideration of aerodynamics, materials, and the use of external features such as storm shutters. These modifications could be integrated into the design and construction of a new structure or applied to reinforce an existing structure.

Manufactured homes, which tend to be vulnerable to the effects of extreme wind events, can be protected by anchoring the structures to their foundations. Mobile homes could be tied

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down to their pads in order to prevent them from being destroyed. Public facilities, critical infrastructure, and public infrastructure (such as signage and traffic signals) should all be windproofed in vulnerable areas. However, windproofing is not a viable mitigation technique to protect against tornadoes.

Wind Shutters

Wind or hurricane shutters can reduce the damages from high winds by preventing windows from breaking allowing wind and rain to enter a structure. Shutters come in various materials and can be purchased or built from scratch.

Wildfire

Fuel Breaks

Fuel breaks are used to prevent the spread of a wildfire. Fuel breaks are areas where vegetation and other fuels have been cleared. Roads and driveways can act as fuel breaks.